MicroSCADA Pro SYS 600 9.2

System Configuration

Configuration Manual

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1. Introduction

1.1. This manual

This manual provides thorough information on the various configuration settings that you have to make in order to take your SYS 600 system into use, focusing on describing how to configure SYS 600 for an IEC 61850 system. The manual also describes how to use the configuration tools.

1.2. Use of symbols

This publication includes the following icons that point out safety-related conditions or other important information:

The caution icon indicates important information or warning related to the concept discussed in the text. It might indicate the presence of a hazard which could result in corruption of software or damage to equipment or property.

The information icon alerts the reader to relevant facts and conditions.

It should be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process performance leading to information or property loss. Therefore, comply fully with all notices.

1.3. Intended audience

This manual is intended for engineers to support configuration and engineering of systems and/or applications.

1.4. Product documentation

Name of the document	Document ID
SYS 600 Application Design	1MRS756170
SYS 600 Application Objects	1MRS756175
SYS 600 Communication Programming Interface (CPI)	1MRS756127
SYS 600 Connecting LONWORKS Devices	1MRS756154
SYS 600 IEC 60870-5-101 Slave Protocol	1MRS756159
SYS 600 IEC 60870-5-104 Slave Protocol	1MRS756162
SYS 600 IEC 61850 System Design	1MRS756119
SYS 600 OPC Data Access Client	1MRS756163
SYS 600 Programming Language SCIL	1MRS756176
SYS 600 System Objects	1MRS756177
IEC 61850 Master Protocol (OPC)	1MRS756230
LIB 500 *4.2. Operation Manual	1MRS755359
RER 111 Technical Reference Manual	1MRS750104-MUM
SPA-ZC 400, SPA to IEC 61850 Gateway, Installation and Commissioning Manual	1MRS755347

Other related documents:

- Microsoft Windows Server 2003 Terminal Server licensing manual
- MMC500_TS.CMD in the Microsoft Windows Server 2003 Terminal Server installation Manual

1.5. Document conventions

The following conventions are used for the presentation of material:

- The words in names of screen elements (for example, the title in the title bar of a dialog, the label for a field of a dialog box) are initially capitalized.
- Capital letters are used for the name of a keyboard key if it is labeled on the keyboard. For example, press the CTRL key. Although the Enter and Shift keys are not labeled they are written in capital letters, e.g. press ENTER.
- Lowercase letters are used for the name of a keyboard key that is not labeled on the keyboard. For example, the space bar, comma key and so on.
- Press CTRL+C indicates that you must hold down the CTRL key while pressing the C key (to copy a selected object in this case).
- Press ALT E C indicates that you press and release each key in sequence (to copy a selected object in this case).
- The names of push and toggle buttons are boldfaced. For example, click **OK**.
- The names of menus and menu items are boldfaced. For example, the **File** menu.
- The following convention is used for menu operations: **Menu Name > Menu Item > Cascaded Menu Item**. For example: select **File > Open > New Project**.
- The **Start** menu name always refers to the **Start** menu on the Windows Task Bar.
- System prompts/messages and user responses/input are shown in the Courier font. For example, if you enter a value out of range, the following message is displayed: `Entered value is not valid.`

You may be told to enter the string MIF349 in a field. The string is shown as follows in the procedure: `MIF349`

- Variables are shown using lowercase letters: sequence name

1.6. Document revisions

Version	Software revision number	Date	History
A	9.2	27.07.2007	Document created

2. Functional overview of SYS 600

For a MicroSCADA Pro system to operate properly, it must be configured for the special environment in which it is operating. MicroSCADA Pro contains configuration software in the form of objects and data files. The configuration software defines:

- Nodes
- Applications
- Device connections
- Communication properties
- Memory capacities, destination addresses, and so on.

The System Configuration Tool manages the configuration of the base system and the PC-NET. In the current version, the following base system and system objects can be created and configured:

- Integrated link to the PC-NET
- PC-NET
- LonTalk (LON), IEC, RP 570, RP 571, LCU500, DNP 3.0, Modbus, SPA, ADLP180M and IEC 61107 protocol lines
- REX, LMK, IEC, SPI, LCU500, DNP, PLC, and SPA Stations
- LON Clock Master and LON Star Coupler

A MicroSCADA Pro system is composed of:

- One or more base systems
- Process communication system
- Operator workplaces
- Peripheral devices

In addition, it can utilize local area networks (LANs).

2.1. System server

The MicroSCADA Pro base systems are control centres that contain the supervisory control and monitoring functions of MicroSCADA Pro. The tasks of a base system are to collect all process-related data from the stations into the process database, distribute the information and to send control commands via the NET communication units.

Each base system is composed of a base system computer including base system software. The base system computer is a standard PC running the Windows operating system. The MicroSCADA Pro base system software is composed of:

- MicroSCADA Pro kernel
- Number of facility programs
- Engineering and system handling tools
- Configuration software
- Application software

The MicroSCADA Pro kernel, as well as most of the engineering and system handling tools, is the same in all base systems independent of the application area or the extent of use.

The configuration software is specified for the base system in question and adapted to the device configuration of the entire MicroSCADA Pro system.

A base system can contain one or more applications as shown in Fig. 2.1.-1. An application includes application software and databases. The application software specifies the functions of the MicroSCADA Pro base system as a supervisory control system. The application software is adapted for a certain process and for the user's needs regarding the level of information, user interface, control operations, and so on. A base system can run several applications in parallel.

Local area networks (LAN) can be used for connecting base systems with other base systems and base systems with workplaces.

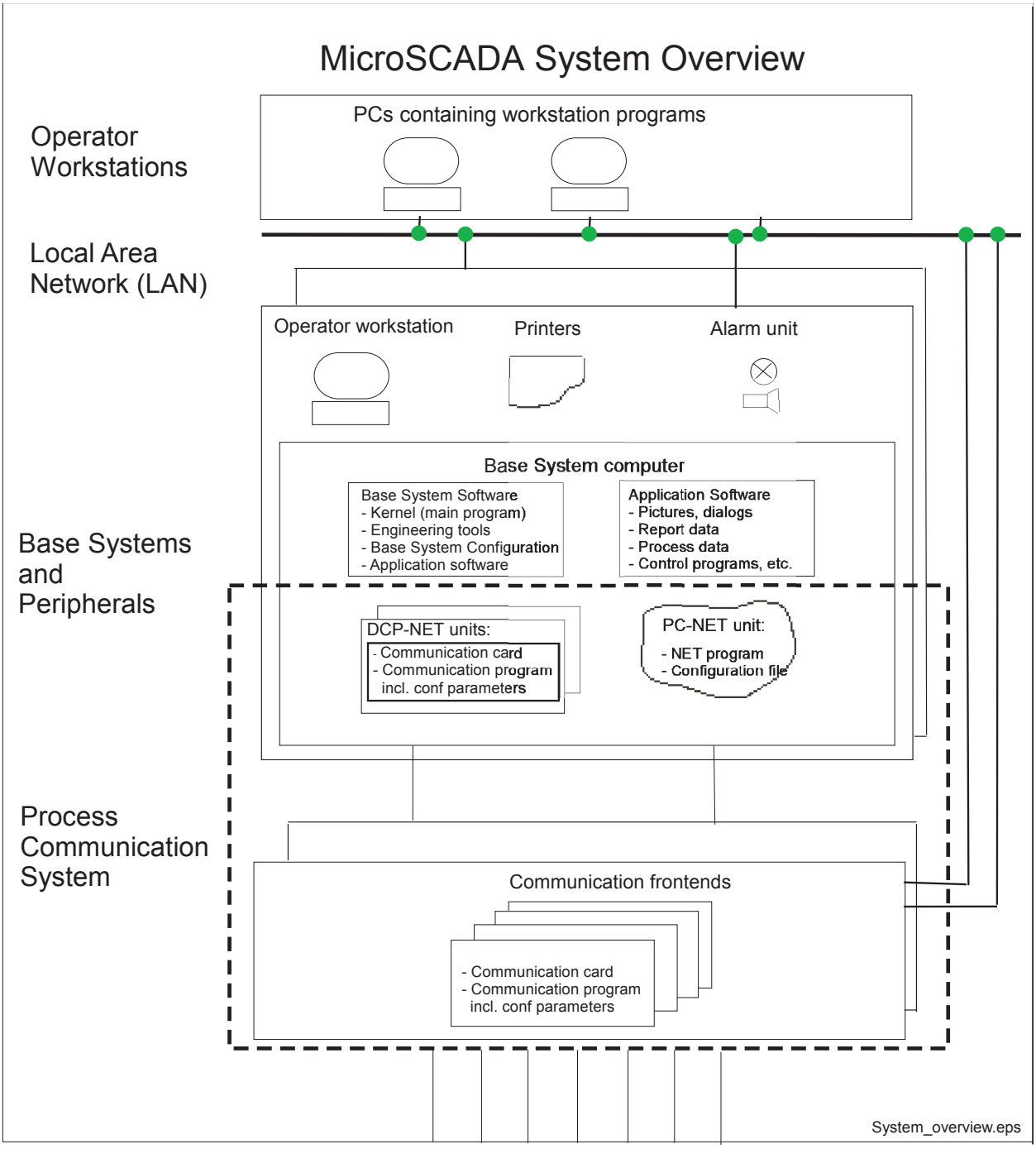

Fig. 2.1.-1 MicroSCADA Pro main system components

2.2. Workplaces

A Workplace is a computer that has a remote desktop session to the server using Microsoft Terminal Services or a Citrix remote session solution.

The workplaces are connected via LAN or via remote connections, which use the operating system feature RAS.

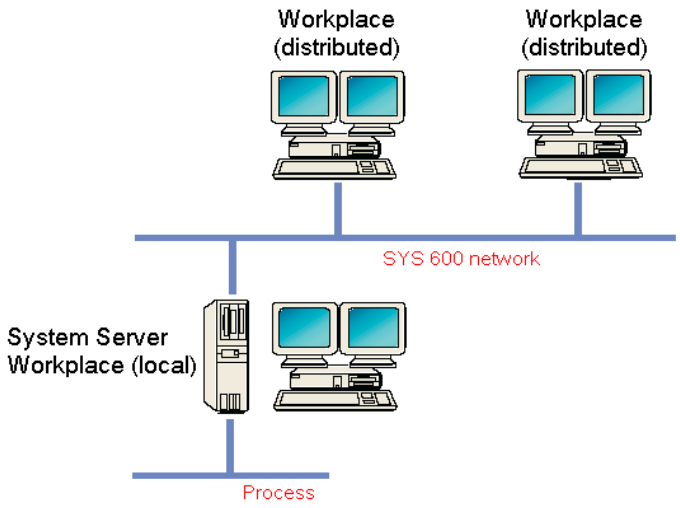

Fig. 2.2.-1 Workplace

2.3. Process communication

The process communication system connects the application software in the base systems with the process stations which gather process data, and performs the control commands. In addition, it can interconnect several base systems, as well as base systems and printers.

The process communication is handled by a number of parallel or serially interconnected communication units, also called NETs. A NET is a communication program running on the CPU of a PC (PC based NETs).

An essential feature of MicroSCADA Pro is the interoperability between separate base systems. Interoperability means that all the connected applications can communicate, if they are situated in the same base system or in separate base systems. In Fig. 2.3.-1, for instance, all applications can intercommunicate. Communication between the base systems 2 and 3 requires some special arrangements in base system 1.

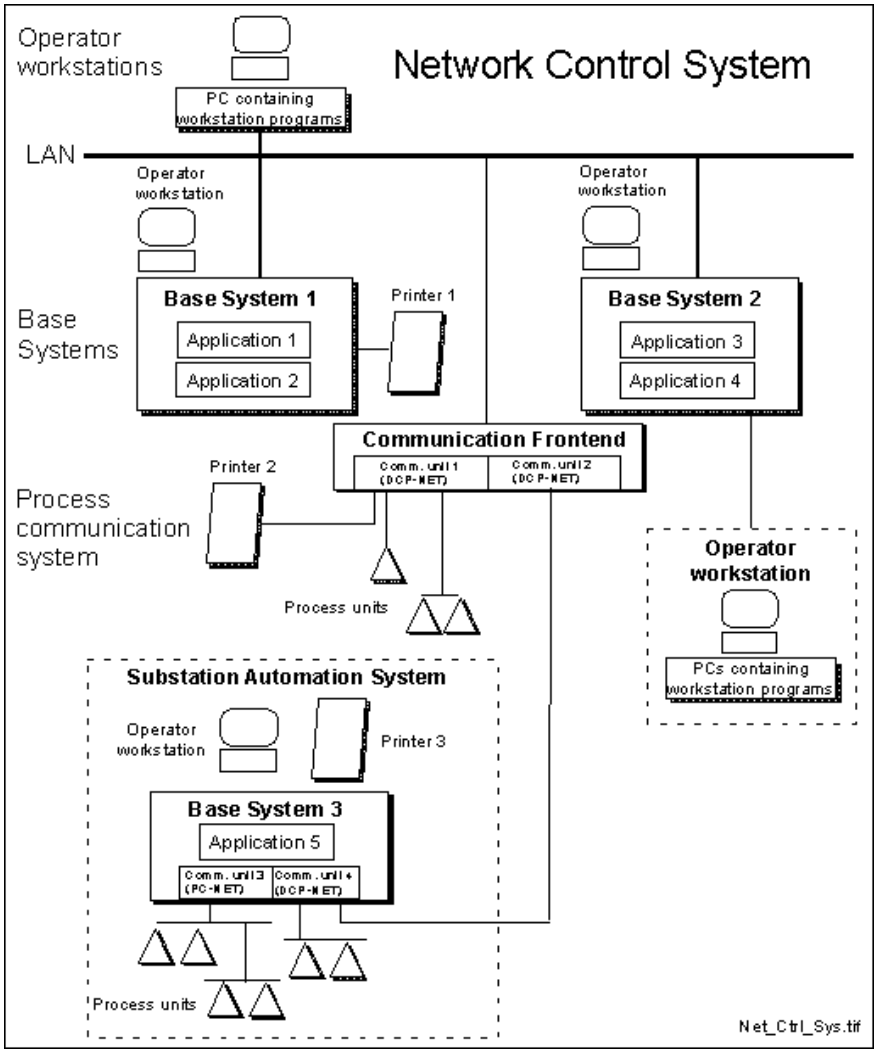

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Fig. 2.3.-1 Network control system

The connected devices - printers, workplaces and process units - can be shared by several base systems in the network. The workplaces connected to a LAN, for example, can be used by all base systems connected to the same LAN. Likewise, the stations and printers connected to NETs can be used by all base systems connected to the same network of interconnected NETs.

In the network of Fig. 2.3.-1, for example, all the applications in base systems 1 and 3 can use the workplaces on the LAN. The Operator Workstations can be connected to several base systems and applications simultaneously. The application 5 can use both printers 1 and 2. A redirection of printout can be done during operation.

2.4. System self supervision

The System self supervision (SSS) is used in MicroSCADA Pro systems for supervising and monitoring the system. It provides the status information of hardware and software by using the symbols of SYS 600 Monitor Pro. System self supervision consists of:

- Supervision application objects
- Supervision monitoring

Supervision application objects contain the source for supervision information to be displayed by supervision monitoring in a supervision display.

2.5. Event handling

An event is an indication that something has happened in the system. Typical events are changes of object values, alarms or warnings, or alarm definitions. Events can cause printouts, automatic control operations, event lists and report database registrations.

The event list displays events that have occurred in the system. It also informs about activities by other users, operations of objects, acknowledging alarms, editing of limit values and so on. With LIB 500 you can define own filters with the event list tool, depending on what kind of information you want in the event list. One or several criteria may be used to filter out unwanted information from the event list.

2.6. Alarm handling

Alarms are generated when something special has occurred in the process. Alarms can cause audio-visual alarms, changes in the station picture, alarm pictures, alarm printouts and alarm lists. Information about alarming objects is stored in the alarm buffer. The information remains in the buffer until the reason for the alarm disappears or until the alarm is acknowledged.

The alarm list shows all the alarms that appear in the system alarm buffer. The alarm list is divided into two different lists: one with persisting (active) alarms and one with fleeting (inactive) alarms. An alarm is usually presented with a text that explains the reason of the alarm.

Alarms and events can be generated in three different ways:

- Process events can generate alarms. The state of the process is evaluated in the base system, according to the limits that have been set. For example, if a measured value exceeds the predefined limits, an alarm will occur.
- The system itself can generate internal alarms from diagnostic programs, which supervise the MicroSCADA Pro system components. An alarm will occur, if there are system communication errors, e.g. if a printer error occurs.
- System alarms are generated by an external module. This module can be considered as a system watch dog. System alarms of this type cannot be included in the alarm list.

Other devices in the MicroSCADA Pro system can also generate alarms.

2.7. Communication gateway

Information needs to be transmitted between the SYS 600 system server and process units. In some cases information from the process units needs to be transmitted to the network control centers as well. Commands sent from the network control centers to process units need to be transmitted in the same way. The data transmission is a task for the communication system. The process unit protocol is often different from the network control center protocol. This is why a protocol conversion is needed.

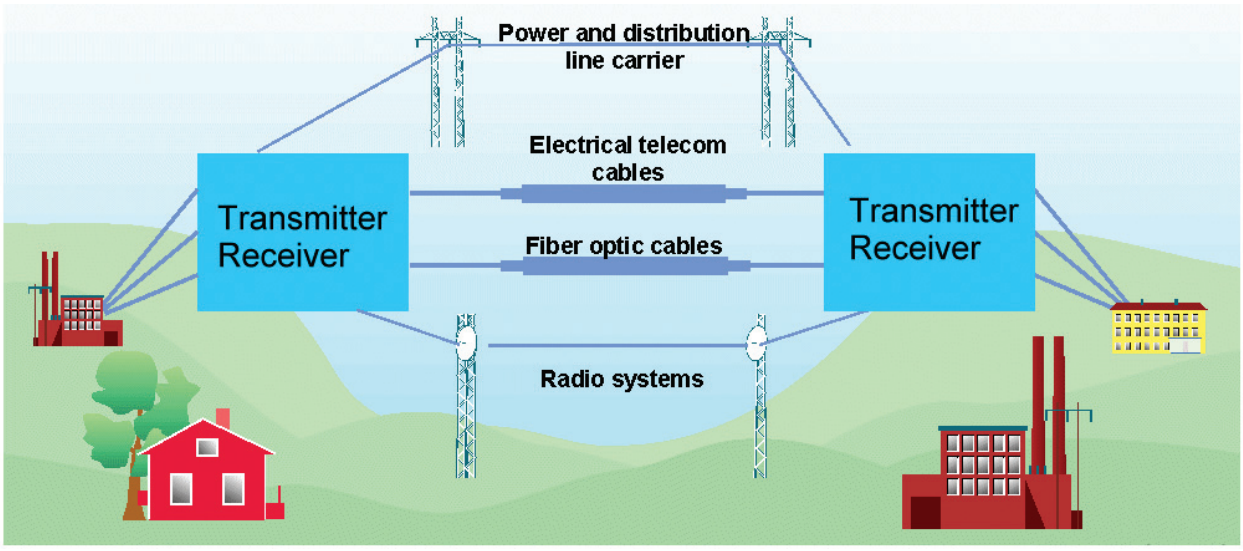

Fig. 2.7.-1 Communication in the electricity distribution

The communication system also handles the communication between other devices in the MicroSCADA Pro system, for example, between two system servers or two communication servers. The communication can be divided into upper level communication and process communication, as shown in Fig. 2.7.-2. Some protocols used for communication are shown in the picture.

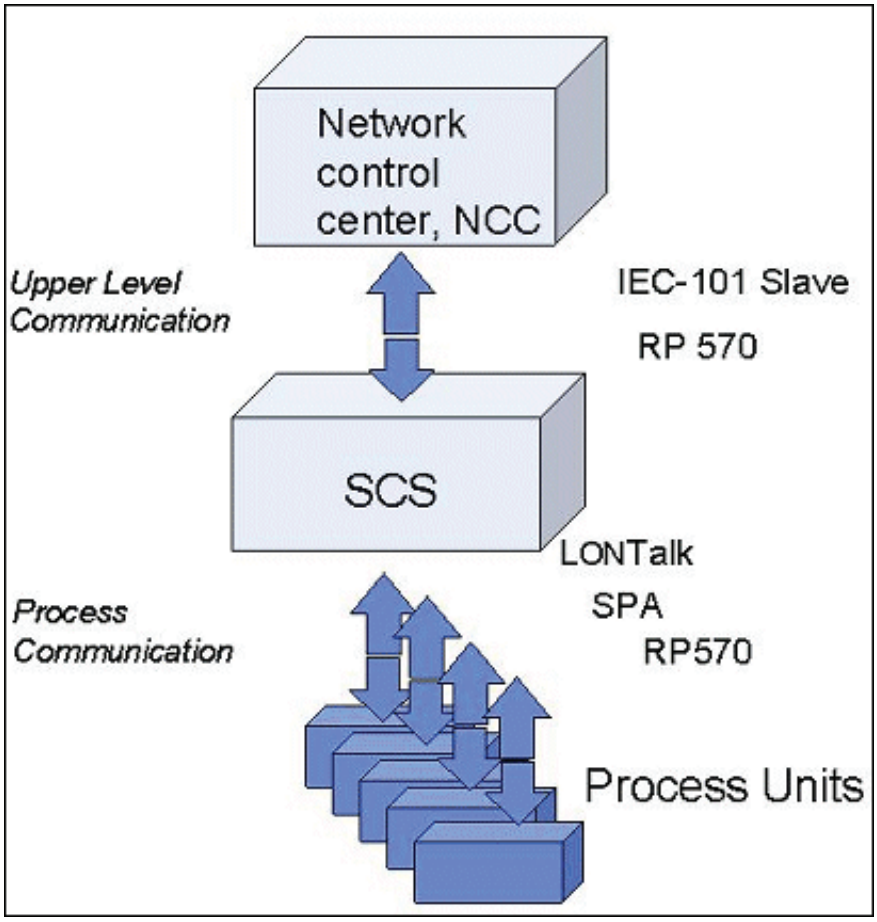

Fig. 2.7.-2 Communication between a NCC (Network Control Center), a COM 500i (Communication Gateway) and process units can be divided into upper level communication and process communication.

Upper level communication means communication between the process units, the COM 500i and the network control center. There can be a SYS 600 system server or a third-party system in the network control center. The upper level communication is usually LAN communication that uses TCP connection or an asynchronous serial communication that uses leased telephone lines, dialed telephone lines, radio links or power line carriers as the physical media.

Process communication is the communication between the COM 500i and the protection and control devices connected to the physical process.

Because of electromagnetic disturbances caused by the primary electric process, optic fibres are mostly used as communication media in the process communication. The communication line is usually faster than the one used in the upper level communication due to the larger quantity of data.

2.8. Peripheral equipment

Peripheral equipments include:

- Printers that are connected to base system computers, to a LAN via printer servers, or to a process communication system.
- Alarm I/O adapter
- Radio clocks for external clock synchronization (DCF77, GPS)

2.8.1. Printers

A base system can have up to 20 printers connected , either directly or through LAN. The printers can be of different types, for example, transparent printers, matrix printers and laser printers. In addition to these printers, the ones defined in the operating system can be accessed by MicroSCADA Pro.

Each printer has a unique printer number, which can be associated with a certain task. For example, the task can be an alarm and event printout, hard copy, historical reports and so on. A printer can be programmed to take over the tasks of another printer automatically.

Printouts can be produced automatically or manually. The layout of a printout can be customized. The main printout types are logs, reports, hard copies and documents. Logs are automatic printouts based on process events. The logs can be directed to one or more printers.

2.8.2. Alarm output I/O

You can define 7 different alarm classes on every process object. The alarm class is of significance when connecting the alarms to audio or audiovisual alarm signals through additional circuit boards. MicroSCADA will support three I/O cards for this purpose. Supported I/O control cards are ADlink Technoloy Inc's NuDAQ PCI-7250, NuDAQ PCI-7256 shown in Fig. 2.8.2.-1, which will support 3.3V PCI bus and Advantech PC-LabCard series PCI-1760.

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Fig. 2.8.2.-1 NuDAQ PCI-7256

2.9. Time handling

There are two different time sources available for accurate time synchronization, GPS and DCF77. SNTP method is used to provide resource to IP network clients. DCF77 radio receivers that are connected directly to PC receive radio timing signals and synchronize Windows platform or MicroSCADA Pro directly.

The most precise time handling method of MicroSCADA Pro system is to use IEC 61850 OPC Server, which can act as an SNTP client and server. For more details, refer to IEC 61850 Configuration Manual.

If IEC 61850 OPC Server is not used, it is possible to use a client program and GPS clock, which synchronize the PC clock. There are many server/client utilities which can be used. Tardis2000 and Yats32 Synchronization applications and Trimble Ace III clocks have been used in customer projects.

Meinberg's board PCI511, as shown in Fig. 2.9.-1, has been designed for the reception of the DCF77 signal, to transfer the time information to a computer with PCI (PCI-X) bus interface and the translation of the received codes into a serial telegram. This solution can synchronize MicroSCADA time.

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Fig. 2.9.-1 Meinberg's PCI511

The board GPS170PCI, as shown in Fig. 2.9.-2, has been designed to synchronize the system time of computers with PCI/PCI-X bus interface.

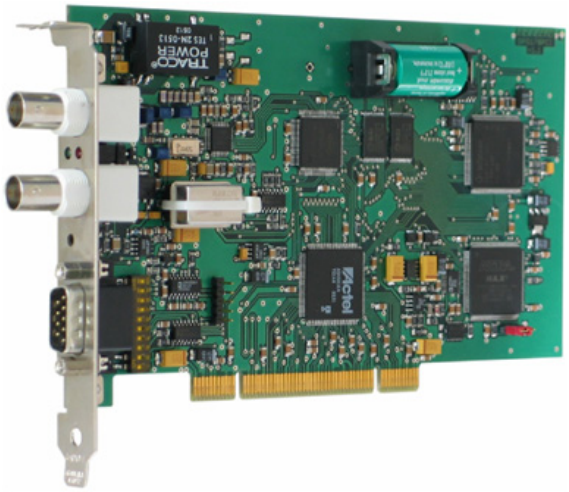

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Fig. 2.9.-2 Meinberg's GPS170PCI Clocks

The synchronization of the Base System Computer connected to the Com Port of the Computer using Meinberg GPS 167, as shown in Fig. 2.9.-3, is also possible.

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Fig. 2.9.-3 Meinberg GPS 167

2.9.1. Time synchronization

For exact and reliable operation, the whole chain between the process and the MicroSCADA Pro databases must be synchronized: the stations, the communication units and the base systems.

The MicroSCADA Pro base system works according to the operating system clock, which is regularly set according to the physical clock of the base system computer. If an external time synchronization source such as a radio clock or a GPS clock is used, it sets the physical clock and the operating system clock regularly. The operator can also set the system time, whereby both the operating system clock and the physical clock are set simultaneously. However, if the computer uses an external time synchronization source, the manual time setting has a temporary effect only, as the time is set regularly by the external time synchronization source. An external time synchronization source of type radio clock can also be connected to a NET unit.

The base system time can be read and written on millisecond level, with an accuracy of 10 milliseconds, with the SCIL functions SYS_TIME and SET_SYS_TIME. For more information on the functions, refer to the Programming Language SCIL manual.

The time of the communication units can be read and written with the NETn:STM attribute.

The time of the stations (S.P.I.D.E.R. RTUs and ANSI stations) are synchronized by means of the Clock Synchronization (SY) attribute. SPACOM units are synchronized automatically.

2.10. Mapping devices

Monitors, printers and stations can be mapped for an application, which means that the application recognizes the devices under logical numbers. The station mapping, for instance, specifies the station numbers under which the application recognizes the stations. The station mapping has the following format:

APLn:BSTi = j

i	The logical station numbers as known to the application and the values.
j	The STA object numbers of the stations.

The printers and stations have a default mapping, which means that each logical application recognizes them under the real object numbers. Therefore, the printer and station mapping is needed only if the application for some reason needs to know the devices under logical numbers. If there are no obstacles, let the logical numbers be the same as the object numbers (that is i = j), that is do not change the default values of printer and station mapping.

The monitor mapping is described in 3.2. Configuring workplaces.

2.11. Redundancy

A single system is a MicroSCADA Pro system that contains only one unit of each system component, while a redundant system can contain two base systems, and/or two NET units and/or two LAN/serial connections dedicated for the same purpose. The idea with a redundant system is to make the system more safe when doubling some of its components. In most systems, the component availability is very important. This means that if one of the system components fails, the other one takes over the specific functions immediately after it has recognized a breakdown in the other base system.

In general, the redundancy in process communication and the upper level communication will follow corresponding standards if specified for the used protocol. For more details, refer to Section 3.8.3. Configuring redundant IEC 60870-5-104 slaves, Section 3.8.5. Configuring redundant IEC 60870-5-101 slaves and Section 3.8.4. Configuring redundant RP 570 slaves.

2.12. Mirroring

Process database mirroring provides a powerful means for sharing process data in a MicroSCADA Pro network with minimal engineering effort. Mirroring can be considered as one implementation of the client/server model of computing. The server application "host" delivers process data to one or more client applications "images". Usually, the host and the images are located in different computers. Local mirroring, that is mirroring between two applications within a MicroSCADA Pro computer, is also supported.

In a hierarchical MicroSCADA Pro network, an image can act further as a host to one or more upper-level images. This is called hierarchical mirroring.

Mirroring can be used in several ways in different network configurations. Some examples are described in 3.9. Configuring mirroring.

The most common use of mirroring is to build a hierarchical control system, where several substations are connected to a network control center, each location running a MicroSCADA Pro system. By using hierarchical mirroring, a wider network containing substations, regional control centers and a main control center can be built. This use is quite close to what COM 500*i* is used for. However, because of a common system architecture and a proprietary communication protocol, the communication is much more efficient and the required engineering work to build up the system is minimal. In addition, several special functions, such as event buffering during communication breaks and handling of hot-stand-by configurations, are automatically taken care of, without any application-level SCIL programming.

Within a substation, one SYS 600 MicroSCADA Pro system can replace the pair of SYS 600 and COM 500*i* systems which were previously often required to control and supervise the substation. Even if COM 500*i* is needed to communicate with a non-MicroSCADA Pro network control center, the sharing of process data between the COM 500*i* and SYS 600 can be done by mirroring. In this case, SYS 600 and COM 500*i* can run as separate applications in one computer.

Mirroring can even be used to share process data among totally different kinds of applications. For example, electrical SCADA and district heating SCADA can share some indications, measurements and events. In this case, both applications can act in double roles, both as a host and as an image.

2.13. OPC connectivity

SYS 600 system provides OPC connectivity towards the process and upper level communication. Process units containing generic OPC server implementation can be connected into SYS 600 system by using the External OPC DA Client or OPC Alarms & Events Client. Additionally SYS 600 system may expose its applications towards upper level systems via OPC Data Access Server, OPC Alarms & Events Server or SYS 600 Application OPC Server.

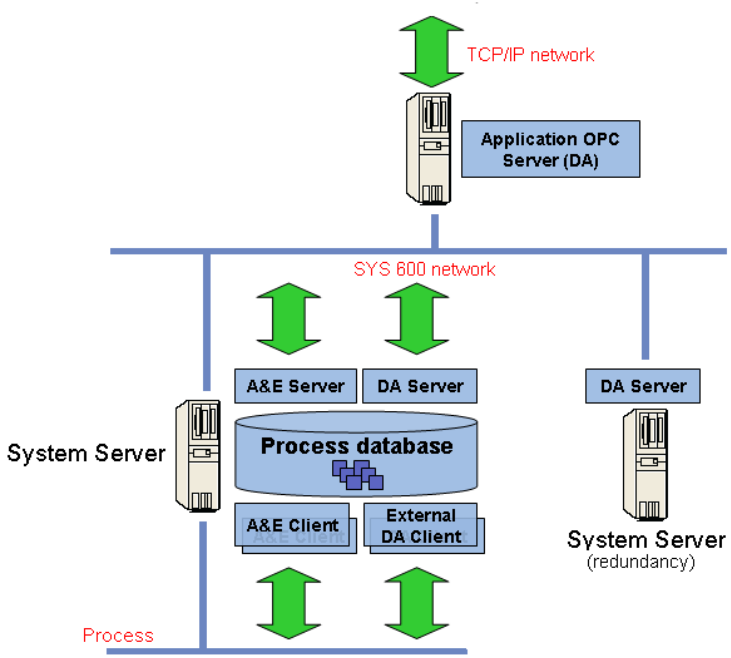

Fig. 2.13.-1 OPC connectivity

2.14. Capacity and performance scalability

The SYS 600 system is highly scalable with regards to capacity and performance. This allows systems of significant differences in size to be built, starting from small monitoring systems with tens of IO's to large systems with hundreds of thousands of IOs.

The capacity and performance of the system is mainly affected by the computer processing capacity, which can be adjusted in two ways:

- by using computer(s) with various processing capacity
- by using various numbers of computers

Computer capacity

The computer type can be selected in order to match the capacity requirements of the system. The most important parameters are:

- CPU performance
- RAM capacity
- Disk capacity

The most important system characteristics that must be considered when designing the system are:

- process communication load
- number of simultaneous workplaces

- intensity of archiving, calculations and reporting
- possible other system specific functions

Distributing processing capacity

In this context one system is characterized by one common image of the process. This means in SYS 600 terms one common process database and one common event archive which allows all alarms and events to be managed in one alarm/event list. If this one common process image is not required the system can be built up of several independent sub-systems, example: with common workplace computers but with individual windows (Monitor Pro) for the different sub-systems.

So in the system there is always one server that hosts the complete process database. This server can of course be redundant (HSB) as described in a separate chapter. The process database is however very efficient and can handle tens of thousands of updates per second. Functions that can be distributed are process communication (PC-NET, IEC 61850 OPC Server & Client), Archiving, Reporting, Workplace processing and other post-processing activities. The distribution of the different functions is done so that each computer is allocated to its own task and the process data is mirrored between the computers by means of the Mirroring function in SYS 600.

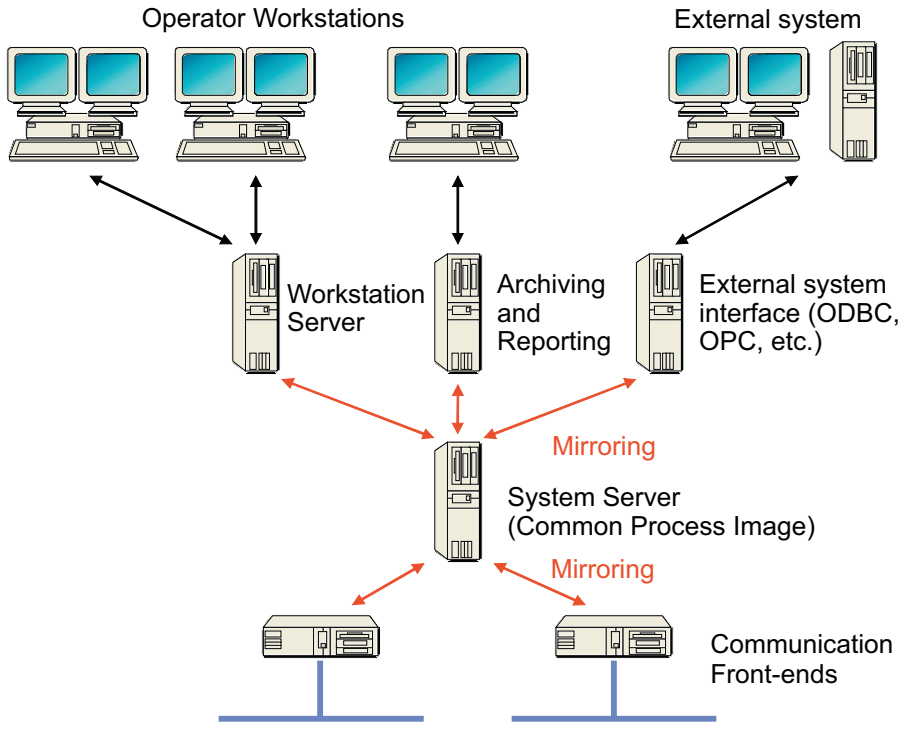

Fig. 2.14.-1 System architecture

The picture above is an example of a system where different functions have been distributed to achieve a higher capacity. The process image of the System Server can be mirrored up to ten different servers. The number of communication front-end

connected to the system server is mainly limited by practical factors and the system server capacity. All nodes connected to the system by means of the mirroring functionality have SYS 600 installed.

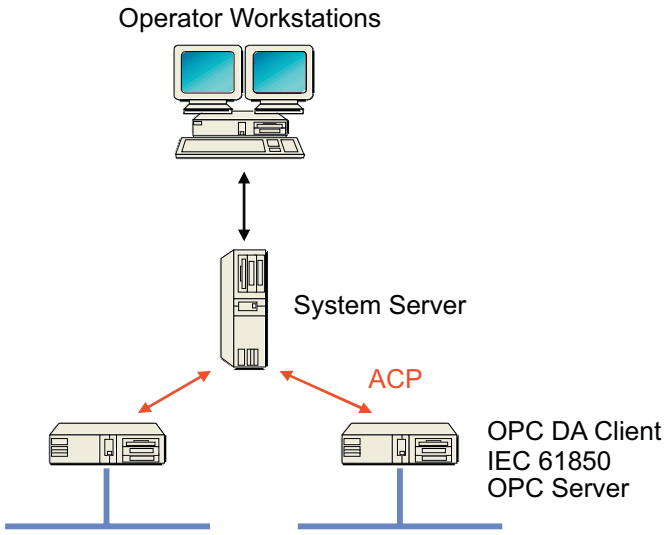

Fig. 2.14.-2 System architecture

The communication front-end can also be distributed in other ways depending on the communication protocols used. In a IEC 61850 system the OPC DA Client and the IEC 61850 OPC server can run in it own computer. Also protocols or protocol converters implemented with CPI (Communication Programming Interface) can run in its own computer. In this configuration SYS 600 is not needed in the front-end computer. For more information on how to build the IEC 61850 system, refer to '***IEC 61850 System Design manual***'.

3. Configuration

The MicroSCADA Pro configuration software is composed of objects and data in the base systems and communication units (NETs), as shown in Fig. 3.1.-1:

- Each base system contains a set of base system objects that specify the base system itself and its environment. During the operation, the base system objects are in the primary memory of the base system computer. The base system objects are created with SCIL commands when the MicroSCADA Pro base system is started. They can be added and modified during the operation.
- Each communication unit contains a set of system objects that specify the unit itself and its environment. During the operation, the system objects are in the memory of the PC (PC-NETs). The NET programs contain a preconfiguration, which gives the system objects default values. The system objects can be added and modified during the system operation.

The process units (stations) contain their own configuration definitions that must be regarded in the MicroSCADA Pro configuration. For some station types, the configuration can be built in MicroSCADA Pro and downloaded to the stations.

Data files

The data files can be changed with a text editor (DOS format). They cannot be changed while the workplace is in operation, because a modification requires that the actual workplace (including the communication units) is restarted.

3.1. Configuring system server

As a rule, when a device is added to the MicroSCADA Pro system, several configuration modules are affected. For example, when a process unit (station) is connected to a NET, additions and modifications are required in:

- Base system which uses it: base system objects.
- Communication unit to which it is directly connected: system objects.

Concerning PC-NET and LONWORKS network, the configuration work is done with the System Configuration Tool. It automatically gives default values which can be changed, if needed.

The MicroSCADA Pro system configuration can be changed any time. However, in some cases a shutdown and restart is required for activating the changes.

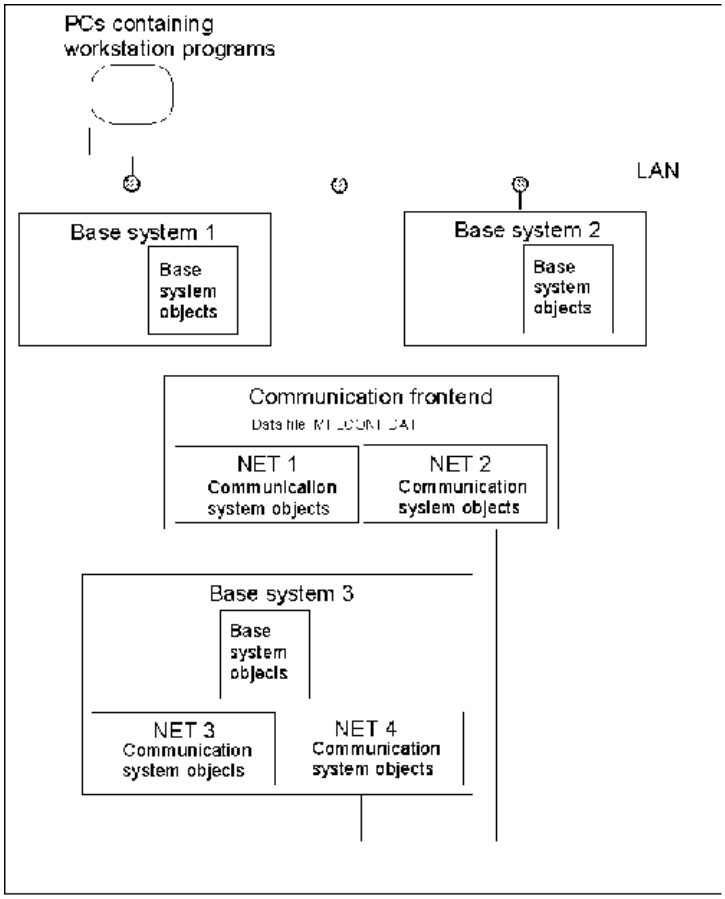

Fig. 3.1.-1 The configuration software modules in MicroSCADA Pro

3.1.1. Hardware and operating system

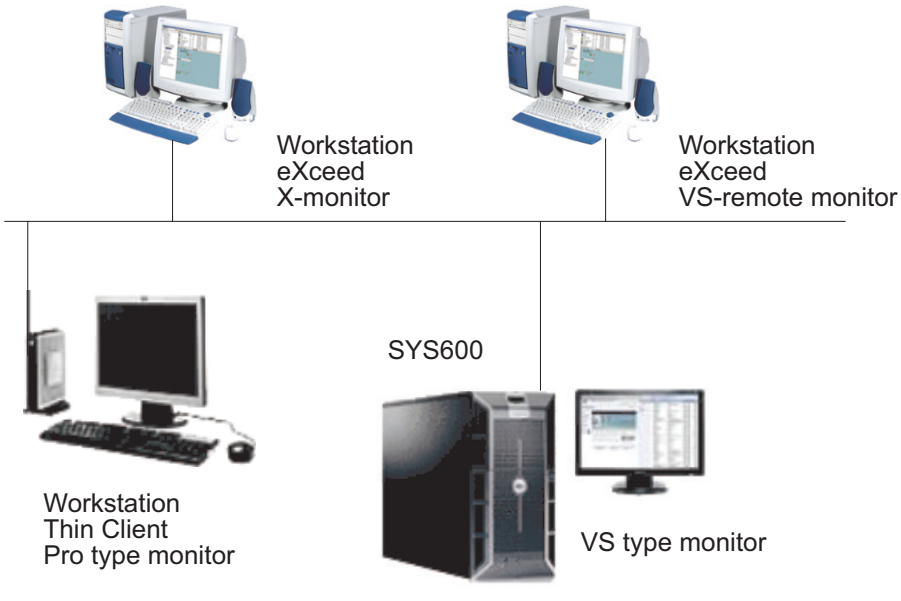

Fig. 3.1.1.-1 Operating system architecture

MicroSCADA Pro supports Intel x86 compatible processors and Microsoft's x32 (32-bit) compatible operating systems: Windows XP, Windows 2000 Server and Windows Server 2003. For information on requirements, refer to ***Installation and Administration Manual***.

MicroSCADA Pro can be installed as part of Windows domain, but it cannot be installed to the domain server. A Windows Domain is a logical grouping of computers that share common security and user account information. This information is stored in a master directory database (SAM) which resides on a Windows server designated as a domain controller.

We recommend to use MicroSCADA in a stand-alone server to avoid complicated errors.

It is possible to run 32-bit programs on Intel x64 architecture processors.

3.1.2. Systems (SYS)

Create a SYS:B object with at least the following attributes (see the example in Fig. 3.1.3.-1):

Table 3.1.2.-1 Mandatory attributes

ND	The node number of the base system. The node number must be unique within the entire MicroSCADA Pro network, see .
SA	The MicroPROTOCOL station address of the base system. Like the node number, the station address must be unique within the network, see .

The following attributes are optional:

Table 3.1.2.-2 Optional attributes

ER	The use of the base system as a routing node. It means that if routing is enabled in a specific base system, it can route messages addressed to other nodes. Refer to the System Objects manual.
DN, DS	The default node number and default station type. These attributes should not be used.
SH	Shadowing attribute. This attribute is used for the configuration of hot stand-by, see 3.8. Configuring redundancy.
TI	Timeout length for node communication. The attribute can be locally and temporarily sidestepped by a SCIL function (TIMEOUT).
PC, RC	Memory cache space attributes, see 'Tuning memory parameters' in this section.
FS	File Sync. The flushing of buffered data on to a disk.
DE	Allowing applications in the base system to be accessed by other software using DDE.
AA	The use of standard audio-visual alarm unit.
CA, CF, CL, TZ	Attributes related to an external clock. Refer to the System Objects manual.

SD, SP	SPACOM devices connected directly to the base system.
DM, TF	Debug mode and time format.

The following attribute is read-only and is therefore not set:

Table 3.1.2.-3 Read-only attribute

DU	The attribute states whether the DDE server is usable or not. Its value is 0, if the DDE server has not been started. If the DDE server has been started, its value is 1 if a user has logged on to the base system computer, otherwise 0.

The SYS:B object definition must come first in the base system configuration file SYS_BASCON.COM, otherwise the system does not start.

3.1.2.1. System configuration

The system configuration of the MicroSCADA Pro base system is defined in the SYS_BASCON.COM configuration file.

The file is a text file containing SCIL statements for creating the base system (B) objects. The System Base Software package contains two SYS_BASCON.COM template files, one for configuring a single base system and one for configuring a hot-stand-by base system. During installation, the template file for a single base system, SYS_BASCON$COM, is copied to SYS_BASCON.COM if the SYS_BASCON.COM does not previously exist. The template file for hot-stand-by systems is called SYS_BASCON.HSB.

The SYS_BASCON$COM template file defines a system configuration as presented in Fig. 3.1.2.1.-1. The configuration consists of an application called “TUTOR”. Two PRI objects, one “normal” and one “transparent”, are connected to the Windows printer manager. Both objects correspond to one physical printer. A third PRI object is connected to a NET node. The fourth PRI object, PRI15, is defined as a log printer printing to a specified log file.

The base system has two communication links to NET nodes. One node is connected to the TCP/IP LAN link. The other node, which is running the PC-NET communication software, is connected over an integrated link to the base system. The configuration allows ten MicroSCADA Pro monitors to be opened to the TUTOR application.

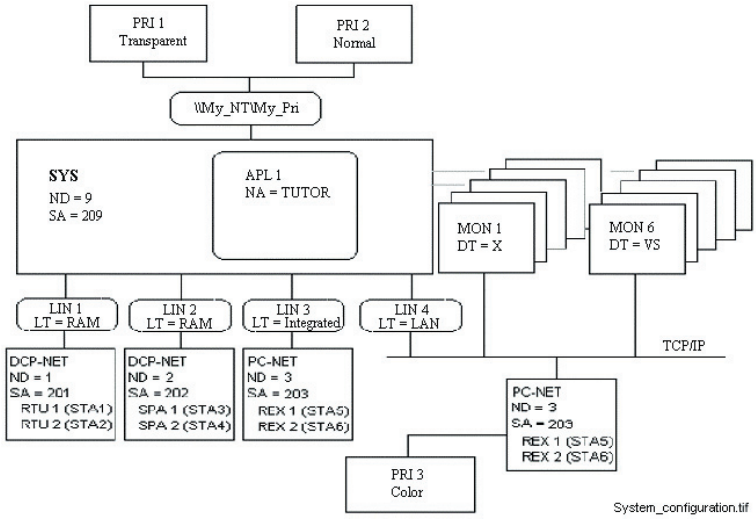

Fig. 3.1.2.1.-1 The system configuration defined by the delivered configuration software

Also the configuration files NET_BASCON.COM and PC_NET.COM, included in the delivery conform with the configuration in Fig. 3.1.2.1.-1.

The contents of the SYS_BASCON$COM file is listed below. Some configuration definitions have been excluded by commenting them. They can be taken into use by removing the comment sign in front of the #CREATE command that creates the base system object.

To edit the current SYS_BASCON.COM:

1. Open the MicroSCADA Pro Control Panel.
2. Click **Admin**.
3. Click **Config**.

The SYS_BASCON.COM file is opened in the Notepad program for editing.

```
;File:     Sys_bascon.com
;Desription: Standard Base system configuration file
;        Version 9.0
;————————————————————————

;————————————————————————
;Base System Object

@l_Standard_Paths = do(read_text("/STool/Def/Path_Def.txt"))

#CREATE SYS:B = List(-
  SA = 209,-            ;Station address of base system
  ND = 9,-             ;Node number of base system
  TM = "SYS",-           ;Time Master, SYS or APL
  TR = "LOCAL",-          ;Time Reference, LOCAL or UTC
  DN = 1,-             ;Default NET node number
  DS = "STA",-           ;Default STA type: E.G. STA,RTU,SPA,REX
  DE = 0,-             ;DDE server 0=disabled, 1=enabled
  OP = 1,-             ;OPC server 0=disabled, 1=enabled
  PC = 6000,-           ;Picture Cache (kB)
  RC = 1000,-           ;Report Cache (kB)
-
- ;MS-STOOL Settings
  PH = %l_Standard_Paths,-
  SV = (0,-            ;System Variables
     list(t_System_Configuration_File = "sys_/SysConf.ini",- ;System
Configuration information
```

```
        b_Conf_Mech_In_Use  = TRUE,- ;enables/disables start-up configuration
        b_SSS_Mech_In_Use  = TRUE,- ;enables/disables system self supervision
routing
        t_Version = "8.4.3")),-
- ;Operating System events
  OE = 0,-             ;1=Enabled, 0=Disabled
  OT = (Bit_Mask(0,1,2,3,4),-  ;Application events (Bit 0=ERROR, 1=WARNING,
2=INFORMATION, 3=AUDIT_SUCCESS, 4=AUDIT_FAILURE)
     Bit_Mask(0,1,2,3,4),-  ;System events (Bit 0=ERROR, 1=WARNING, 2=INFORMATION,
3=AUDIT_SUCCESS, 4=AUDIT_FAILURE)
      Bit_Mask(0,1,2,3,4)),- ;Security events (Bit 0=ERROR, 1=WARNING,
2=INFORMATION, 3=AUDIT_SUCCESS, 4=AUDIT_FAILURE)
-
  FS = "NEVER")          ;File sync. criteria: NEVER,MAINT,SET,CHECKPOINT,ALWAYS


;_____________________________
;Communication Links
;NOTE! Use the System Configuration Tool to create a link for the PC-NET!

#CREATE LIN:V = LIST(-         ;Link to DCP-NET (requires DCP driver)
  LT = "RAM",-     ;Link type
  SD = "RM00",-    ;DCP card (first:RM00, second RM01)
  RE = "BCC",-     ;Redundancy
  TI = 2,-       ;Timeout length (s)
  NA = 3,-       ;NAK limit
  EN = 3)        ;ENQ limit
;#CREATE LIN1:B = %LIN

#CREATE LIN:V = LIST(-         ;Link to other SYS or LAN frontend (requires TCP/IP)
  LT = "LAN")      ;Link type
;#CREATE LIN2:B = %LIN

;_____________________________
;Node objects (NET's and SYS's)
;NOTE! Use the System Configuration Tool to create nodes for the PC-NET!

#CREATE NOD:V = LIST(-         ;Node for DCP-NET
  LI = 1,-       ;Link number
  SA = 201)       ;Station address: 0..255
;#CREATE NOD1:B = %NOD

#CREATE NOD:V = LIST(-         ;Node for LAN frontend or SYS
  LI = 2,-
  SA = 202)
;#CREATE NOD2:B = %NOD


;_____________________________
;Printers

;#do Read_Text("sys_/pr_default.dat")   ;This line is needed for the transparent
printer below
;#CREATE PRI:V = LIST(-           ;Transparent type printer
;  TT = "LOCAL",-      ;Translation type
;  DT = "TRANSPARENT",-  ;Device type
;  OJ = 1,-          ;Printer opened on job basis
;  DC = "LINE",-      ;Device connection: CONSOLE, LINE OR NET
;  CS = %CS,-        ;Control sequences
;  SD = "\\My_NT\My_Printer",-  ;System device name
;  LP = 66)          ;Lines per page
;#CREATE PRI1:B = %PRI

#CREATE PRI:V = LIST(-
  TT = "LOCAL",-
  DT = "NORMAL",-
  DC = "LINE",-
  SD = "\\My_NT\My_Printer",-
  LP = 66)
;#CREATE PRI2:B = %PRI

#CREATE PRI:V = LIST(-
  TT = "LOCAL",-
  DT = "COLOR",-
  DC = "NET",-
  ND = 4,-         ;NET node number: 1..99
  TN = 1,-         ;Translated object number (printer nr in net)
  LP = 66)
;#CREATE PRI3:B = %PRI

;#CREATE PRI:V = LIST(-           ;Required if HP of application is "EVENT_LOG"
(History logging Policy)
```

```
;  TT = "LOCAL",-
;  OD = "LOG",-      ;Output destination (LOG, PRINTER)
;  LL = "DAY",-      ;Log Length (DAY, WEEK, MONTH)
;  LD = "/APL/TUTOR/PICT",-  ;Log directory
;  LP = 0)
;#CREATE PRI15:B = %PRI

;_____________________________
;Monitors

#LOOP_WITH I = 1..5
  #Create MON' I' :B = LIST(-
    TT = "LOCAL",-    ;Translation type
    DT = "VS")      ;Visual SCIL monitor
  @MON_MAP(%I) = -1
#LOOP_END

#LOOP_WITH I = 6..10
  #CREATE MON' I' :B = LIST(-
    TT = "LOCAL",-    ;Translation type
    DT = "X")       ;X monitor
  @MON_MAP(%I) = -1
#LOOP_END


;_____________________________
;Applications

;The usage of OI  OX -attributes (required by LIB 500)
@SV(15) = LIST(-
        Process_Objects=LIST(-
         OI=LIST(-
           Title1=VECTOR("Substation"),-
           Title2=VECTOR("Bay"),-
           Title3=VECTOR("Device"),-
           Title4=VECTOR(""),-
           Title5=VECTOR(""),-
           Length1=10,-
           Length2=15,-
           Length3=5,-
           Length4=0,-
           Length5=0,-
           Field1=VECTOR("STA"),-
           Field2=VECTOR("BAY"),-
           Field3=VECTOR("DEV"),-
           Field4=VECTOR(""),-
           Field5=VECTOR("")),-
         OX=LIST(-
           Title1=VECTOR("Object text"),-
           Length1=30)))

;Create Application specific global paths
@l_Global_Paths = list()

;Add LIB5xx global paths to list if LIB5xx installed
@t_LIB_Path_Def_File = "/LIB4/Base/Bbone/Use/Bgu_Glpath.txt"
#if File_Manager("EXISTS", Fm_Scil_File(%t_LIB_Path_Def_File)) #then #block
  #error continue
  @v_File_Contents = read_text(%t_LIB_Path_Def_File)
  #if substr(%v_File_Contents(1),5,16) == "LIB 500 revision" and substr(%
v_File_Contents(1),22,5) >= "4.0.2" #then #block
    #modify l_Global_Paths:v = do(read_text(%t_LIB_Path_Def_File))
  #block_end
  #error stop
#block_end

#if substr(SYS:BPR, 1, 7) == "SYS_600" #then #block ; PP

  ;Add SA_LIB global paths to list
  @t_SALIB_Path_Def_File = "/SA_LIB/Base/Bbone/Use/Bgu_Glpath.txt"
  #if File_Manager("EXISTS", Fm_Scil_File(%t_SALIB_Path_Def_File)) #then #block
    #error continue
    @v_File_Contents = read_text(%t_SALIB_Path_Def_File)
    #if substr(%v_File_Contents(1),5,14) == "SA LIB version" and substr(%
v_File_Contents(1),20,5) >= "1.0.0" #then #block
      #modify l_Global_Paths:v = do(read_text(%t_sALIB_Path_Def_File))
    #block_end
    #error stop
  #block_end

#block_end
```

```
#CREATE APL:V = LIST(-
   TT = "LOCAL",-    ;Translation Type
   NA = "TUTOR",-    ;Name of application directory
   AS = "HOT",-     ;Application state (COLD,WARM,HOT)
   PH = %l_Global_Paths,-
-;  PQ = 15,-              ;Number of parallel queues/ Needed in COM500 Applications
-;   QD = (1,1,0,0,0,0,1,1,1,1,1,1,1,1),- ;Parallel queue dedication/ Needed in
COM500 Applications
   SV = %SV,-      ;System variable (RESERVED)
   CP = "SHARED",-   ;Color Allocation Policy
-;   RC = VECTOR("FILE_FUNCTIONS_CREATE_DIRECTORIES"),- ;Revision compatibility
   HP = "DATABASE",-  ;History Logging Policy ("DATABASE", "EVENT_LOG", "NONE")
   EE = 1,-       ;System Events  Operating System Events (1=Enabled, 0=Disabled)
   AA = 1,-       ;Number of APL-APL servers
   MO = %MON_MAP,-   ;Monitor mapping
   PR = (1,2,3))    ;Printer mapping
#CREATE APL1:B = %APL

;#CREATE APL:V = LIST(- ;LIB5xx Demo Application
;   TT = "LOCAL",-    ;Translation Type
;   NA = "510_403_1",- ;Name of application directory
;   AS = "HOT",-     ;Application state (COLD,WARM,HOT)
;   PH = %l_Global_Paths,-
;   SV = %SV,-      ;System variable (RESERVED)
;   CP = "SHARED",-   ;Color Allocation Policy
;   RC = VECTOR("FILE_FUNCTIONS_CREATE_DIRECTORIES"),- ;Revision compatibility
;   HP = "DATABASE",-  ;History Logging Policy ("DATABASE", "EVENT_LOG", "NONE")
;   EE = 0,-       ;System Events  Operating System Events (1=Enabled, 0=Disabled)
;   MO = %MON_MAP,-   ;Monitor mapping
;   PR = (1,2,3))    ;Printer mapping
;#CREATE APL1:B = %APL

;_____________________________
;Station Types

#SET STY3:BCX  = "ANSI X3-28"
#SET STY4:BCX  = "SPIDER RTUs"
#SET STY5:BCX  = "SINDAC (ADLP80 S)"
#SET STY6:BCX  = "P214"
#SET STY7:BCX  = "SINDAC (ADLP180)"
#SET STY8:BCX  = "PAC-5"
#SET STY9:BCX  = "SATTCON/COMLI"
#SET STY17:BCX = "LON"
#SET STY20:BCX = "LCU 500"
#SET STY21:BCX = "SPACOM"
#CREATE STY22:B = LIST(NA = "SPI", DB = "STA", CX = "S.P.I.D.E.R/RP570")
#CREATE STY23:B = LIST(NA = "LMK", DB = "REX", CX = "LonMark")
#CREATE STY24:B = LIST(NA = "ADE", DB = "STA", CX = "Ademco")
#CREATE STY25:B = LIST(NA = "PCO", DB = "STA", CX = "Procontic / RCOM")
#CREATE STY26:B = LIST(NA = "WES", DB = "STA", CX = "Westinghouse")
#CREATE STY27:B = LIST(NA = "ATR", DB = "STA", CX = "Alpha Meter")
#CREATE STY28:B = LIST(NA = "PLC", DB = "RTU", CX = "PLC")
#SET STY29:BCX  = "IEC"
#SET STY30:BCX  = "DNP"

;_____________________________
;Node, Link for PC-NET  Stations

@i_Status = do (read_text("Sys_Tool/Create_C.scl"), "BASE_SYSTEM")

;_____________________________
;LAN node name of the computer
  @t_lan_node_name = "Basesystem1"

  @i_system_node         = SYS:BND
  #set nod' i_system_node' :bnn = %t_lan_node_name

;_____________________________
;Other Stations
;NOTE! Use the System Configuration Tool to create stations for the PC-NET!

;NET 1 (DCP-NET) stations
;#CREATE STA:V = LIST(-
;  TT = "EXTERNAL",-
;  ST = "RTU",-
;  ND = 1,-
;  TN = 1)
;#CREATE STA1:B  = %STA
```

If the MicroSCADA Pro base system revision 8.4.2 or later is used together with applications that were created with earlier revisions of the base system, for example by using LIB 4.0.1, the revision compatibility switch NO_ALIAS_CHECKING should be turned on. This is done by adding "NO_ALIAS_CHECKING" to the RC attribute of the application in SYS_BASCON.COM.

SYS_BASCON.COM:

```
#CREATE APL:V = LIST(-
   ...
   RC =
VECTOR("FILE_FUNCTIONS_CREATE_DIRECTORIES","NO_ALIAS_CHECKING") ,-
   ...
```

3.1.2.2. Memory configuration

The configuration file SYS_CONFIG.PAR is a text file containing settings of system parameters that cannot be set with SCIL. The file is read at system start-up before the execution of SYS_BASCON.COM. The configuration file SYS_CONFIG.PAR can be edited with a text editor.

SYS_CONFIG.PAR can contain the following parameters and set values:

- MEMORY_POOL_SIZE specifies the size of the global memory pool in megabytes (MB). Possible values are divisible with four, that is 4, 8, 12, 16, 20, 24, and so on. The default is 64 MB, if no value is given in SYS_CONFIG.PAR.

  For example the line: `MEMORY_POOL_SIZE = 100` sets the size of the global memory pool to 100 MB.

- MEMORY_POOL_ADDRESS specifies the start virtual address of the global memory pool. The start address (default value 30000000) should be changed to a new value by trial and error or examining the DrWatson log if the start of a monitor or an external program (Application Extension Program or Integrated Program) fails and the message “? Map_Global_Memory (MapViewOfFileEx): 487” is shown in the Notification Window.

  The address is given as an 8-digit hexadecimal number with 6 trailing zeroes. Any value between 20000000 and 6F000000 can be tried. A good value is found quickly, if sequence 20000000, 28000000, 30000000, and so on is used. When a valid value is found, it can be used in all MicroSCADA Pro installations running the same external programs and the same operating system configuration. The value does not depend on MicroSCADA Pro configuration, such as number of monitors or network connections.

  The parameter MEMORY_POOL_HOLE offers an alternative and recommended way of finding a valid memory pool address. It is easier to use, because the MicroSCADA Pro program does the trial-and-error procedure.

- MEMORY_POOL_HOLE advises the MicroSCADA Pro start-up code not to use the specified virtual memory area for the global memory pool. The parameter should be written into the parameter file only if a monitor process or an external program fails to initialize and displays an error message of the following format in the Notification Window (and SYS_ERROR.LOG):

```
Add the following line to sys_config.par and restart MicroSCADA Pro
MEMORY_POOL_HOLE = 30000000 - 301FFFFF
```

The line should be copied to sys_config.par exactly as shown in the error message. Do not touch the parameter MEMORY_POOL_ADDRESS. After a restart, the program should start without errors. The configuration file can contain several MEMORY_POOL_HOLE lines, because there is a slight possibility that even the second start-up fails now suggesting another hole in the pool address space.

- PICO_MEMORY_POOL_SIZE
- REPR_MEMORY_POOL_SIZE
- PRIN_MEMORY_POOL_SIZE

  These three parameters define the sizes of the local memory pools of MicroSCADA Pro processes:

  - PICO_MEMORY_POOL_SIZE determines the size (as megabytes) of the local memory pool of all the monitor processes in the system. The default value is 16 MB.
  - REPR_MEMORY_POOL_SIZE determines the size of the local memory pool of all repr processes. The default value is 8 MB.
  - PRIN_MEMORY_POOL_SIZE determines the size of the local memory pool of all prin processes. The default value is 4 MB.

  Setting a pool size to 0 demands the processes of the category to always use the global memory pool.

  If a process requires more memory than the specified memory pool size allows, the dialog box "SCIL Application Error/Memory Pool Exhausted" is displayed. The dialog box displays a critical error with information about which pool caused the error. The information is either "Local memory pool exhausted" or "Global memory pool exhausted".

- ANALOG_SWITCH_STATE_CLOSED (default = 1)
- ANALOG_SWITCH_STATE_OPEN (default = 2)
- ANALOG_SWITCH_STATE_MIDDLE (default = 0)

  These parameters define the translation of the CLOSED, OPEN and MIDDLE states returned by the program interface function SCIL_Get_Switch_State.

  If the SYS_CONFIG.PAR file does not exist, the default values are used.

  A template, SYS_CONFIG$PAR is copied to \sc\sys\active\sys_ during the installation of the System Base Software package. The contents of the SYS_CONFIG$PAR is:

```
;File:     Sys_config.par
;Description: Configuration for 'static' base system parameters
;        leading ';' indicates commented line
;        Version 9.0
;————————————————————————
```

```
;
;MEMORY_POOL_ADDRESS      = 30000000 ;Memory pool start address
;MEMORY_POOL_SIZE        = 64     ;Must be 4,8,12,16,20,24,28,... (MB)
;PICO_MEMORY_POOL_SIZE     = 16     ;Memory Pool for Monitor processes
;REPR_MEMORY_POOL_SIZE     = 8      ;Memory Pool for Report processes
;PRIN_MEMORY_POOL_SIZE     = 4      ;Memory pool for Printer processes
;
;ANALOG_SWITCH_STATE_OPEN    = 2      ;The semantics for MicroTOPOLOGY of AI
;ANALOG_SWITCH_STATE_CLOSED  = 1      ;process objects used for indicating the
;ANALOG_SWITCH_STATE_MIDDLE  = 0      ;state of a switching device
```

3.1.3. Applications (APL)

A local application is situated in the base system in question, which means that all the application software is stored in the computer as a directory branch under the application directory apl. For example, the application software of the local application "sample" is stored in the directory \sc\apl\sample.

The application directory branch with its subdirectories must exist before a local application can be defined in the base system configuration (refer to the Installation manual).

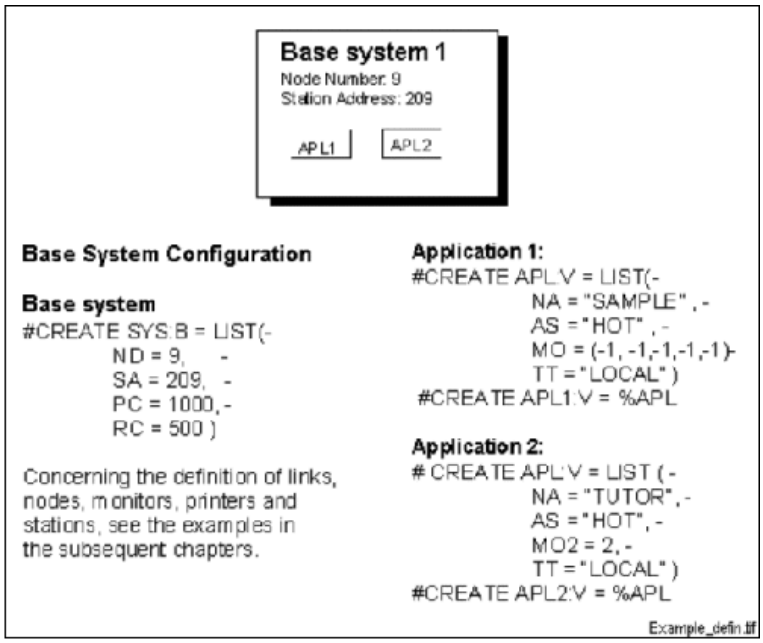

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Fig. 3.1.3.-1 Example of the fundamental definition of a base system and the definition of two local applications.

3.1.3.1. Configuring APL objects

Create an APLn:B object ('n' = 1 ... 250) and assign it the following attributes (refer to the ***System Objects manual***):

NA	Application Name. The application name is the name of the application directory branch containing the application software (for example "SAMPLE" according to the example above).
MP	Monitor mapping, see the headline "Device Mapping" below.
AS	"HOT" if the application is running.
AP	Application mapping if the application communicates with other applications within the same or in different base systems (see).
ST, PR	Printer and station mapping. These attributes are generally not needed, see the headline "Device Mapping" below.
TT	"LOCAL"
EM, HB, PM	History buffer and queue lengths, see the headline "Tuning Memory Parameters".
PQ	Number of parallel queues.
QL	Maximum length of process queries.

See the examples in Fig. 3.1.3.-1.

At least one local application must be created in SYS_BASCON.COM, given a name (NA), set to "LOCAL" (TT) and to "HOT" (AS) and mapped for at least one monitor (MO).

The application that is created first in SYS_BASCON.COM is the default application. If no application number is given when opening a MicroSCADA Pro monitor, the default application is chosen. Likewise, if no application number given when using the program interface, the default application is addressed.

3.1.3.2. Mapping devices

Monitors, printers and stations can be mapped for an application, which means that the application recognizes the devices under logical numbers. The station mapping, for instance, specifies the station numbers under which the application recognizes the stations. The station mapping has the following format:

APLn:BSTi = j

i	The logical station numbers as known to the application and the values.
j	The STA object numbers of the stations.

The printers and stations have a default mapping, which means that each logical application recognizes them under the real object numbers. Therefore, the printer and station mapping is needed only if the application for some reason needs to know the devices under logical numbers. If there are no obstacles, let the logical numbers be the same as the object numbers (that is i = j), that is do not change the default values of printer and station mapping.

The monitor mapping is described in 3.2. Configuring workplaces.

3.1.3.3. Tuning memory parameters

The allocation and use of the available RAM memory is affected by the following base system attributes:

- The SYS:B attributes PC (Picture Cache Size) and RC (Report Cache Size), refer to the System Objects manual.
- The APLn:B attribute HB (History Buffer), refer to the System Objects manual.
- The picture cache and report cache memory space is common to all the applications in the base system. The cache memories contain only objects and pictures that have been in use, but are not currently running. The maximum cache space is specified by the PC and RC attributes. When these limits are reached, the least used objects are removed.

During operation, there should be at least 500 kB free memory. The MF, MS and MU attributes can be used for reading the occupied and the free memory space (refer to the System Objects manual). If there is not enough free memory, memory is taken from the picture and report caches.

3.1.3.4. Adding applications

To add a MicroSCADA application, follow the instructions given below:

1. Open **Control MicroSCADA Applications** dialog from MicroSCADA Control Panel/Admin/Application, as shown in Fig. 3.1.3.4.-1
2. Click **Add** button and type in the application name.
3. Click **OK**.

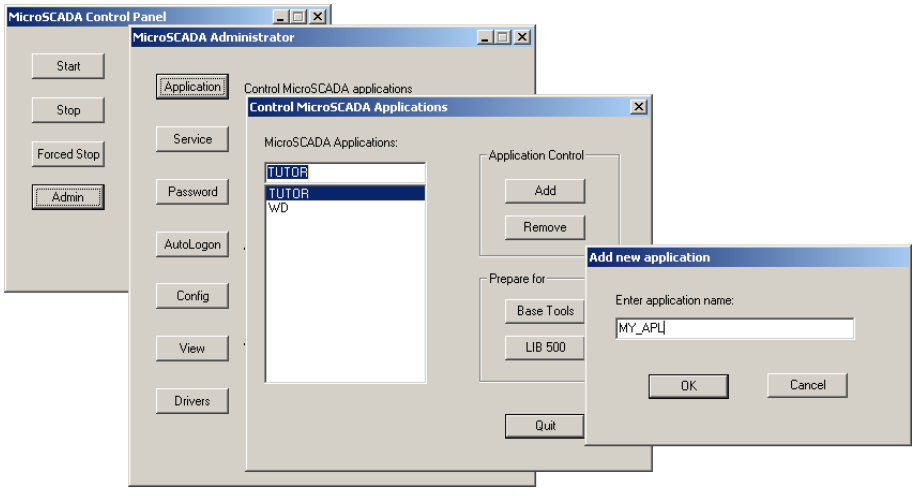

Fig. 3.1.3.4.-1 Adding an application

4. Depending on the usage of the application, prepare it for LIB 500 and/or for COM 500.
5. Define application characteristic in file SYS_BASCON.COM.
6. When MicroSCADA is started for the next time, application definitions are taken in use.

3.1.3.5. Removing applications

To remove a MicroSCADA application, follow the steps given below:

1. Stop running MicroSCADA.
2. Open **Control MicroSCADA Applications** dialog from MicroSCADA Control Panel/Admin/Application.
3. Select application from the list.
4. Click **Remove** button.
5. Confirm operation.
6. Remove application definitions from the SYS_BASCON.COM.

3.2. Configuring workplaces

3.2.1. Windows terminal server

Terminal Services is a component of Microsoft Windows operating systems. It allows a user to access applications on a remote computer over a network connection. Terminal Services is Microsoft's take on server centric computing. Based on the Remote Desktop Protocol (RDP), Terminal Services was first introduced in Windows NT 4.0 Terminal Server Edition. Next server products, Windows 2000 Server and Windows Server 2003 have introduced several improvements and new features. Terminal Services in Windows Server operating systems provides a new option for MicroSCADA monitor deployment. This is required to open new MicroSCADA Pro monitors from LAN connected workstations.

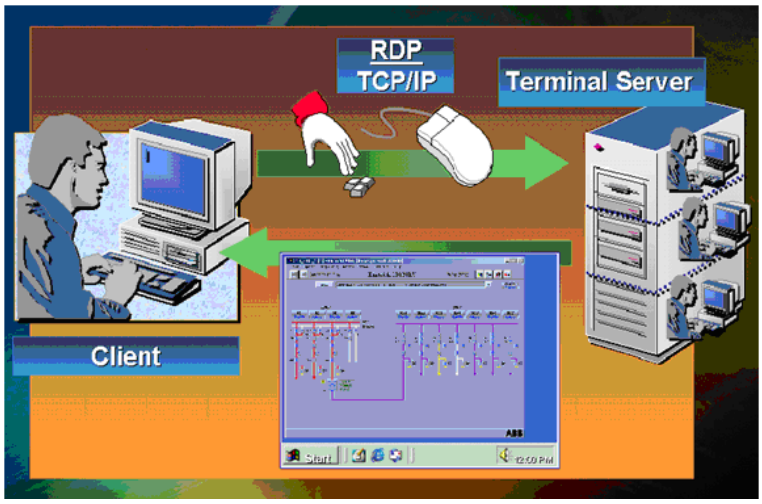

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Fig. 3.2.1.-1 Windows terminal server

Operating System Licensing

Windows Server License

The Windows Server 2003 licensing model requires a server license for each copy of the server software installed. Terminal Services function is included in the Windows Server license.

Windows Server Client Access License

In addition to a server license, a Windows Server Client Access License (CAL) is also required. If you want to conduct a Windows session, an incremental Terminal Server Client Access License (TS CAL) is required as well. A Windows session is defined as a session during which the server software hosts a graphical user interface on a device. For Windows sessions, a TS CAL is required for each user or device.

Terminal Server Client Access Licenses

Two types of Terminal Server Client Access Licenses are available: TS Device CAL and TS User CAL. A TS Device CAL permits one device (used by any user) to conduct Windows Sessions on any of your servers. A TS User CAL permits one user (using any device) to conduct Windows Sessions on any of your servers. A single license server can support multiple terminal servers. There can be one or more license servers in a domain, or throughout a site.

The Terminal Server Licensing Model

Terminal Server Licensing operates between several components, as shown in Fig. 3.2.1.-2:

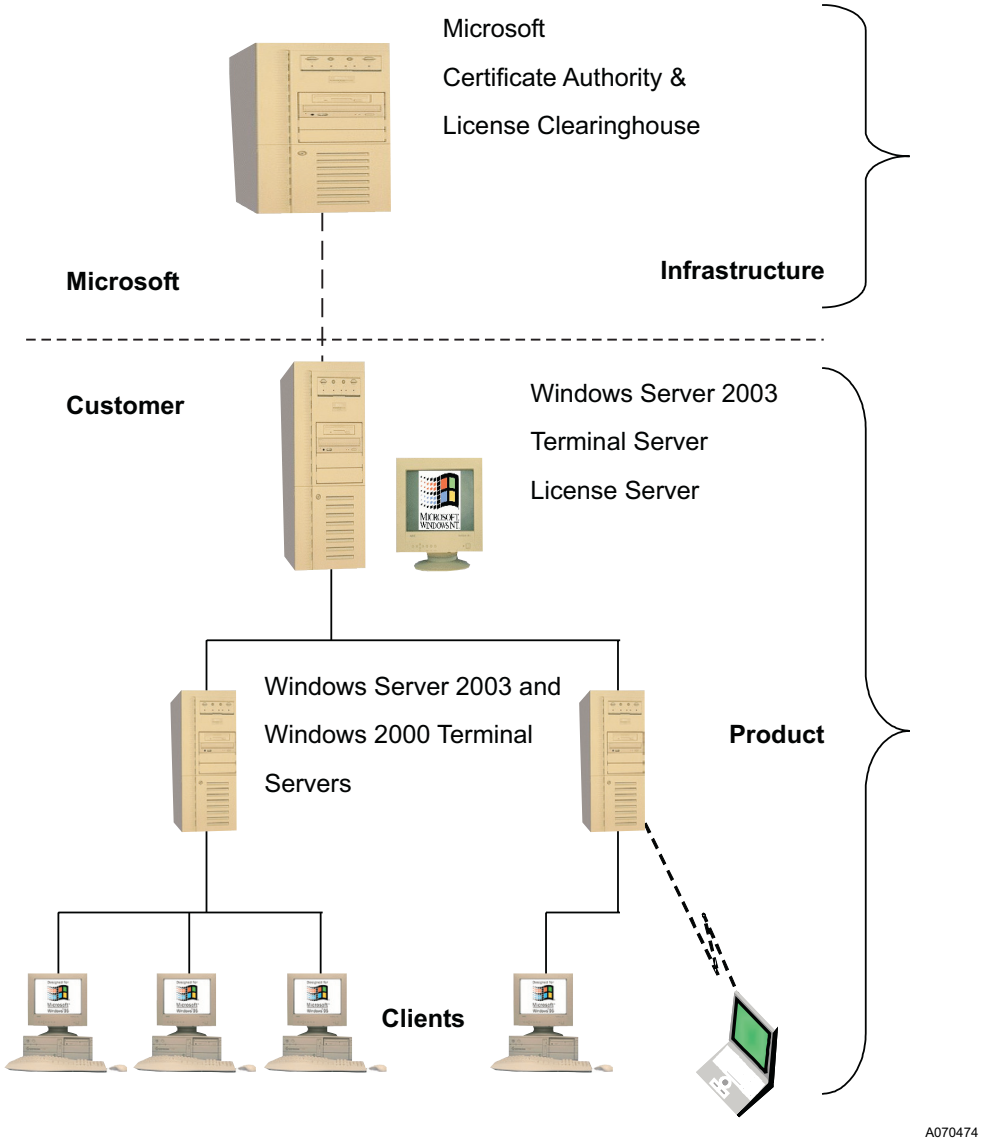

Fig. 3.2.1.-2 Terminal server licensing model

For more information, refer to the Microsoft Windows Server 2003 Terminal Server Licensing manual available in Microsoft's website.

Operating mode: Application Server or Remote Administration

Terminal Services may be enabled in one of the two modes: Application Server or Remote Administration. Application server mode allows multiple remote clients to access Windows-based applications that run on the server. This mode must be used if many concurrent MicroSCADA Pro sessions are opened.

Remote administration mode is designed to provide operators and administrators remote access. This feature allows you to connect to and manage a server remotely for up to two connections. Since this is designed as a single-user remote access solution, no Terminal Server Client Access License (CAL) is required to use Remote Administration.

Windows XP Remote Desktop allows the same function as Windows Server 2003 Terminal Services. But there is always only one active remote desktop session at a time. If someone logs into the computer from a remote location, the local user is disconnected.

Terminal Services works with client computers and terminals by using the Remote Desktop Protocol (RDP). Terminal Services Client software for Windows-based computers (RDP –clients) is included in Windows Server operating systems. Non-Windows-based clients require a third party add-on.

3.2.2. Citrix MetaFrame Application Server

Windows 2000/2003 Terminal Services supports the native Microsoft Remote Desktop Protocol (RDP) as well as the Citrix Independent Computing Architecture (ICA) protocol (via the Citrix add-on).

Citrix MetaFrame/Presentation Server is a remote access/application publishing product built on the Independent Computing Architecture (ICA), Citrix Systems' thin client protocol.

This package consists of a handful of products that run on Windows Servers and go beyond what Windows Terminal Services can do. Support of larger displays than on Windows Server 2003 Terminal Services and seamless window mode (no frame on application window) for instance are features, which can be achieved by using Citrix features and may be useful in the MicroSCADA Pro work place.

The following table provides an overview of the features available with each of these protocols:

Table 3.2.2.-1 Overview of the features

Feature	Description	RDP 5.1	ICA
Clients	Windows CE-based thin client	x	x
	Windows XP Embedded-based thin client	x	x
	ActiveX	x	x
Transport	TCP/IP	x	x
	SPX, IPX, NetBEUI		x
	WAN connection	x	x
	Dial-up, VPN, xDSL	x	x
	Direct dial-up (non-RAS)		
Audio	System beeps	x	x
	Stereo Windows audio		x
Local printing	Printing to a local printer attached to a thin client	x	x

Table 3.2.2.-1 Overview of the features (Continued)

Feature	Description	RDP 5.1	ICA
Local drive mapping	Local drives accessible from server-based applications	x	x
Local port redirection	Redirection of server ports (LPT/COM) to local client ports	x	x
Cut and paste	Cut and paste of text and graphics between client and server	x	x
User-centric Session Access	Client remembers previous user's logon name for each connection	x	
	Connect to an active or disconnected session using a different screen resolution.	x	
	Connect directly to an application rather than to an entire desktop.	x	x
	Server-based applications resize and minimize similar to local applications.		x
Application publishing	Advertise server-based applications directly to client desktops.		x
Resolution	16-bit color depth	x	x
Load balancing	Pooling of servers behind a single server address and for increased availability.	x	x
Remote control	Viewing and interacting with other client sessions (also called “shadowing”).	x	x
Bitmap caching	Optionally cache display bitmaps in memory for improved performance.	x	x
	Optionally cache display bitmaps to disk for improved performance.	x	x

Table 3.2.2.-1 Overview of the features (Continued)

Feature	Description	RDP 5.1	ICA
Encryption	Multiple-level encryption for security of client communications.	x	x
	Multiple-level encryption on Windows CE thin clients.	x	
Automatic client update	Administrative means for updating client connection software from the server.	x	x
Pre-configured client	Predefined client with published applications, IP addresses, server names and connection options.	x	x

3.2.2.1. Verifying client connections

A computer that can be accessed by a user working at a remote location is known as host. Remote computer is known as the client. The remote desktop connection client software must be installed in it. Use ping utility to check that TCP/IP connection between your server and work station is functional. Next, check the Terminal Services connection by opening desktop for a user on the server. To do this, select **Start > Programs (or All Programs) > Accessories > Communications > Remote Desktop Connection**, as shown in Fig. 3.2.2.1.-1.

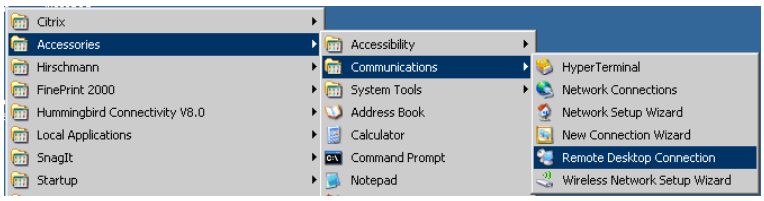

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Fig. 3.2.2.1.-1 Opening Remote Desktop Connection

Fill in the computer name or IP address of the host and click **Connect**. Log on to Windows dialog box by typing your user name and password.

The Citrix client must be installed on your workstation computer to open ICA connections. It can be installed from Citrix MetaFrame installation CD or can be downloaded for free from Citrix website.

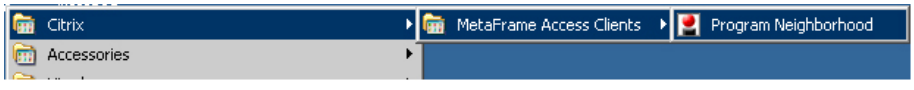

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Fig. 3.2.2.1.-2 Opening Program Neighborhood

1. Open **Program Neighbourhood** as shown in Fig. 3.2.2.1.-2.
2. Create connection client.
3. Type name for the connection, add server address, set options for connection and give logon information.

   If no application is given, then a desktop is connected in the ICA window. You must have created user information on the server you want to log in.

If you are not allowed to open client connection, check whether terminal services and licensing services are installed on server. Also check the other server side connection settings, as shown in Fig. 3.2.2.1.-3.

1. Open **Terminal Services Configuration**.
2. In the console tree, click **Connections**.
3. In the details pane, right-click the connection you want to modify, and then click **Properties**.

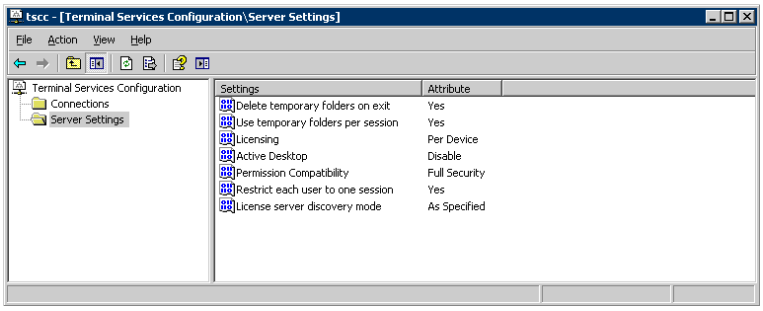

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Fig. 3.2.2.1.-3 Modifying connection settings

3.2.3. WinnConn XP Server/BeTwin

Common feature for these products is to provide an alternative to Windows Server 2003 operating system as MicroSCADA Pro base system. It is possible to save in operating system costs and licenses fees especially in small systems.

Following products allow multiple persons to connect and to use a single Windows XP computer from remote:

- WinConnect Server XP software (IPConsult B.V.) allows a server installed with Windows® XP Pro to host up to 21 remote desktop sessions easily and cost effectively.
- BeTwin (ThinSoft Inc) is a software that enables two to five users to share the computing power and resources of a single computer.

All these products include their own manuals for installation and application running. One common feature with Windows Server 2003 installation is, that you must use register.exe utility to set .dll files available globally to the system and to all users. This utility is not included either of these two systems. For more information, refer to ***MMC500_TS.CMD in Installation Manual***.

3.2.4. Defining MON objects

Base system configuration

Each Classic monitor must be defined as a MON object in the connected base system. Pro Monitors do not need MON objects. In addition, the MON objects must be mapped for the applications, which uses them. The monitor objects are defined equally whether they are opened on the base system monitor or on a workplace. Fig. 3.2.4.-1 shows an example of a workplace with three MicroSCADA Pro monitors opened to three applications in two separate base systems.

Make the following object definitions in each base system:

1. Create MONn:B objects, one for each MicroSCADA Pro application monitor that is opened on the base system monitor or on connected workplaces, see Chapter 7. Assign the MON objects the following attributes:

   DT = “VS” or “X”. Define the monitor as “VS” type, unless it should be able to show Motif widgets

   TT = "LOCAL"

   You can create up to 100 MON objects per base system.

2. Define monitor numbers for each application by setting the APLn:BMO attribute to -1 by using freely chosen monitor numbers as indexes.

   Example:

   APL1:BMO(1..5) = (-1,-1,-1,-1,-1)

   means that monitor numbers 1 ... 5 can be opened to view application 1.

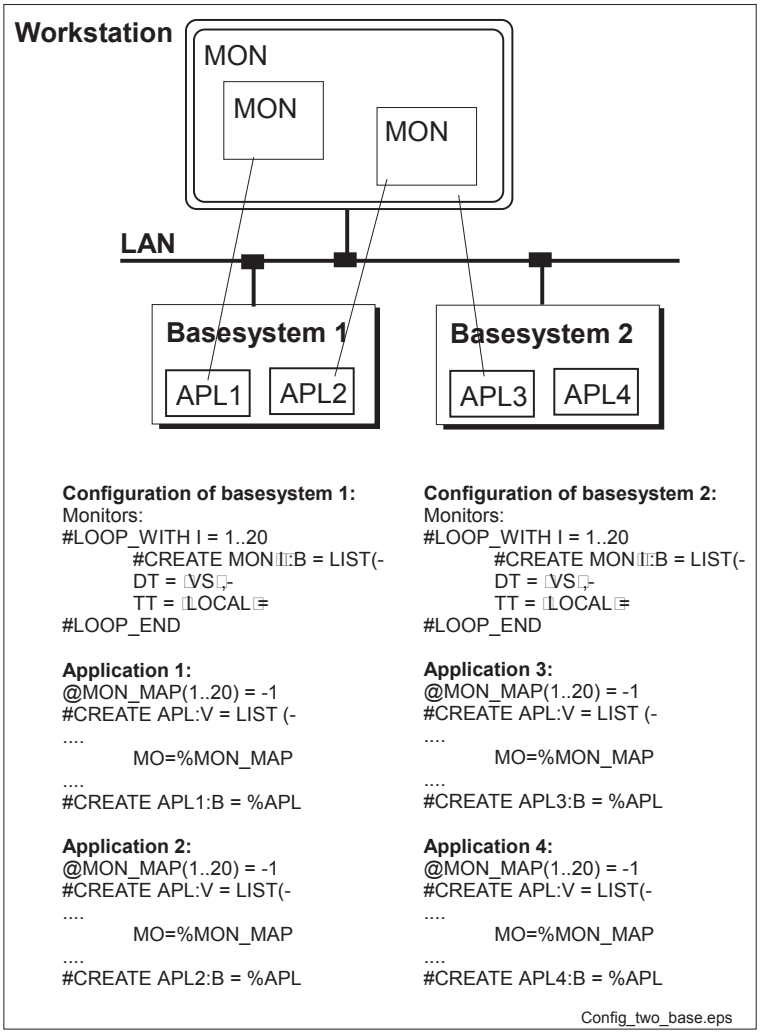

Fig. 3.2.4.-1 Example of a workplace that is connected to two base systems and four applications

3.2.5. Monitor Pro Configuration

Command Line Support

Usage

FrameWindow.exe	[process|event|alarm(template)|blocking|trends (mode)|reports(mode) display] -ll:x,y -ur:x,y -coordsys:world|screen [process display] -display:ulx,uly,width,height -login [username] [password][application] [process|event|alarm(template)|blocking|trends (mode)|reports (mode) display] [event|alarm|trends|reports preconf] -loginonce -logoutonce -closeonce [process|event|alarm(template)|blocking|trends (mode)|reports(mode) display] [event|alarm|trends|reports preconf] -loginscript [.bat file] -light -wait
[process display]	Opens Process display (path to .v file)
[event display]	Opens an event display (eventlist). Preconfiguration can be given as an additional argument
[|alarm(template) display]	Opens an alarm display in an appropriate template (alarmlist_temp1|alarmlist_temp2). Preconfiguration can be given as an additional argument
[blocking display].	Opens blocking display (blockinglist)
[trends(mode) display]	Opens trends display in an appropriate mode (trends_graphical|trends_tabular). Preconfiguration can be given as an additional argument
[reports(mode) display]	Opens a reports display in an appropriate mode (reports_graphical|reports_tabular). Preconfiguration can be given as an additional argument
-ll:x,y	Zooms in the lower left coordinates (x,y) of a process display
-ur:x,y	Zooms in the upper right coordinates (x,y) of a process display
-coordsys:world|screen	Defines the coordinate system, if flags -ll and -ur are defined. The world coordinate system is used by default
-display:ulx,uly,width, height	Monitor Pro upper left coordinates (ulx, uly), width and height (width, height)
-login	Logs on to the application. Login dialog is displayed, if only the application has been started. The display can be an additional argument
-loginonce	Logs on to the application that the last Monitor Pro has logged into. Display can be additional an argument
-logoutonce	Logs out from all Monitor Pro windows with an appropriate user that has the argument defined
-closeonce	Closes all Monitor Pro windows with an appropriate user that has the argument defined
-loginscript	Runs the contents of a BAT file after a successful logon
-lang	Defines the default language used in Monitor Pro when not logged in to any application
-light	Starts Monitor Pro without toolbars and menus
-wait	Waits for MicroSCADA Service to start.

Process Display Specific Configuration Files

Common Process Display Specific Menu Files

Common process display specific menu files are common for all process displays. Those are seen in process display specific menu before the separator (if some user has logged in Monitor Pro). Process display specific menu files are after the separator. For example:

Example

FrameWindow.exe	C:\samplepic.v
FrameWindow.exe	C:\samplepic.v -ll:100,400 -ur:300,500
FrameWindow.exe	C:\samplepic.v -display:0,0,400,400
FrameWindow.exe	C:\samplepic.v -light
FrameWindow.exe	alarmlist_temp1
FrameWindow.exe	-loginscript C:\samplefile.bat
FrameWindow.exe	C:\samplepic.v -loginscript C:\samplefile.bat
FrameWindow.exe	eventlist -loginscript C:\samplefile.bat
FrameWindow.exe	-login 510_403_1
FrameWindow.exe	-login demo "" 510_403_1
FrameWindow.exe	-login demo "" 510_403_1 C:\samplepic.v
FrameWindow.exe	-login demo "" 510_403_1 trends_graphical my_trend_preconf
FrameWindow.exe	-login demo "" 510_403_1 alarmlist_temp1 my_alarm_preconf
FrameWindow.	exe -login demo "" 510_403_1 eventlist my_event_preconf
FrameWindow.exe	-loginonce C:\samplepic.v
FrameWindow.exe	-loginonce alarmlist_temp1
FrameWindow.exe	-loginonce -loginscript C:\samplefile.bat
FrameWindow.exe	-loginonce eventlist -loginscript C:\samplefile.bat

Application Specific

Application specific common process display specific menu files are in folder [Appl path]\PAR\APL\PROCESS\MENU.

User Specific

User specific common process display specific menu files are in folder [User path] \PROCESS\MENU. If the folder exist the contents of application common process display specific menu folder is not investigated at all. This makes it possible for example to skip the application common process display specific menu files if needed by just defining an empty user specific one.

Visibility Shortcut Files

If visibility files have been defined the following operations are blocked:

- File open-menu item won't let user to open any process graphics pictures
- Process graphics picture drag'n'drop to application window is not allowed.
- Custom commands concerning opening process graphics displays is blocked.

Application Specific

The shortcut files in [Appl path]\PAR\APL\PROCESS\TOOLBAR_SHORTCUTS are shown to all users in application process displays toolbar in Monitor Pro. If this folder is not empty (excluding user specific folders) the files in [Appl path]\PICT\ are left investigated. Other process displays than the ones in application process displays toolbar are not allowed to open.

For backwards compatibility the existing files in old folder are moved programmatically to new folder when Monitor Pro is started.

User Specific

The shortcut files in [User path]\PROCESS\TOOLBAR_SHORTCUTS\ are shown to appropriate user only in application process displays toolbar in Monitor Pro. If this folder is not empty the files in [Appl path]\PICT\ folder and application specific shortcut files are left investigated. Other process displays than the ones in application process displays toolbar are not allowed to open.

For backwards compatibility the existing files in old folder are moved programmatically to new folder when Monitor Pro is started.

Process display menu

A process display menu displays both the common parts for the process pictures and the specific parts for the currently active process picture.

The menu structure is similar to the Windows Start menu. The menu commands are organized as folders and files in the file system. Therefore, no special tool is needed to configure the menu. The configuration is done by organizing the files, such as programs, documents or shortcuts and the directories in a file system. For example, a menu command can be:

- a file
- a folder containing submenu commands
- a link
- a shortcut to a file
- a shortcut to a directory
- an Internet hyperlink

Defining shortcuts to process displays

The user access rights can be restricted by showing the needed process displays as shortcuts. The user can only open the process displays shown in a toolbar, if the shortcut files have been defined.

The following operations are unavailable for the user:

- Opening process displays by using the menu operation **Main > Open File**.
- Dragging process displays to an application window.
- Custom commands related to opening the process displays are blocked.

Shortcut files must be there at the operating system level. Copying the picture is not the right way to create the shortcuts.

Application specific process display shortcuts are shown to all users. The shortcut files are located in Appl path]\PAR\APL\PROCESS\TOOLBAR_SHORTCUTS. The user is not allowed to open process displays that are not defined on toolbar of the application specific process displays.

User specific process display shortcuts are shown individually to each user. The user specific shortcut files are located in [User path]\PROCESS \TOOLBAR_SHORTCUTS. The user is not allowed to open process displays that are not defined on toolbar of the user specific process displays.

If the user specific shortcut files exists, the application specific files are ignored.

Process Display Context Menus

MENUS directory

MENUS directory consists of directories such as all, objecttypes and instances.

- Menu commands, which are to be shown on each shortcut menu, should be stored under the directory all.
- The directory objecttypes consists of all object types that a station overview can have. Menu commands that each object type can have are also located here.
- It is also possible that an instance of a breaker might have some menu commands that are instance specific, such as a figure of a breaker, online video stream, maintenance log or a web link to the manufacturers home page. In that case, the menu commands are located in \<unique object id>.
- The menu for all objects are located in <apl>\MENUS\all.

SYS 600 supports two-letter language codes. When generating the menu structure, use the /culture <language> option. When the option is selected, the menu commands are displayed under the culture specific folder.

Table 3.2.5.-1 Menu command descriptions

Name	Description	Path
<apl>	Path of the application	E.g. C:\sc\apl\510_403_1
<object type>	For more information about object types, refer to Section 13.5.7. Object types	<apl>\MENUS\objecttypes\ <object type>(common menu for an object type
<display name>	Name of the display file (without extension .v)	

Menu structures are not shadowed. If a HSB system is used, the menus have to be manually copied between Hot/Stand-by - computers after the modifications have been done. Otherwise, the directories are deleted during the switch-over.

Troubleshooting

Table 3.2.5.-2 Possible problems with context-sensitive shortcut menus

Description of the problem	Possible cause	Solution
Only a description of a shortcut menu is displayed. A message 'No items' or the icon indicates that the shortcut menu is empty	There are no commands in the menu directory, that is, menu is empty.	Check that the application has a menu structure, see section 13.5 in *Application Design Manual*. Furthermore, check whether a culture has been defined similar to the user for the menu structure.
The folder is displayed as a menu command and can be browsed. The folder does not contain submenu commands		
The Open With dialog is displayed when running a menu command	The file type of the menu command is unknown. The file has not been associated with any program	Use the Open With dialog to select the program in which you want to open the file
A menu command is disabled	User is not authorized to run the menu command or a link target does not exist	Check the authorization level or the link target
The custom object type does not have menu commands	A menu structure was not generated for the custom object type or the type does not have an SAObjectType attribute	Add a menu structure manually for the custom object type and ensure that the object has an SAObjectType attribute
An instance specific menu structure is not created for a symbol	No view was defined when the menu structure was generated or the symbol's Object Name field is empty	Use Display Builder to set the Object Name field for the symbol. Run the menu generator and use a viewpath argument to generate menus for instances

3.3. Configuring process communication

The configuration of process communication is divided into the following configuration tasks:

- Configuring communication system objects in base system
- Configuring process communication units (PC-NET, OPC DA Client, CPI applications)

In general, the process communication units cannot be created or accessed from any application before the corresponding system objects in base system has been configured. The definition method of these system objects depends on used process communication unit type.

The required base system object types are as following:

- **NODn:B** object which in this context defines the node of process communication unit itself
- **LINn:B** object which defines a communication route from the base system to the defined node
- **STAn:B** object which defines a station within a defined node
- **PRIn:B** object which defines a printer within a defined node

If the used process communication unit is of type PC-NET and System Configuration Tool is used, these base system objects are created automatically. If the System Configuration Tool is not used or the used process communication units are other than PC-NET, refer to Section 4.1.7.1. Loading online configuration for more information. System Configuration Tool supports only process communication units of type PC-NET.

These objects can be also be configured using SYS_BASCON.COM as described in Section 3.1.2. Systems (SYS) or with SCIL using statement `#CREATE`.

3.3.1. Configuring communication system objects in base system

Following system objects are needed for each process communication unit:

Links (LIN)

A link is a data transmission line to another base system, a NET unit or a device. Each link is defined by a LINn:B object (n = 1 ... 20). A base system can have the following links:

- One link of type “LAN”. The process communication unit may be directly connected through LAN link. The LAN link is used between base systems and the process communication unit may be connected to another base system (indirect connection). The definition of LAN links is described in Section 3.7.2. Communicating between applications.
- One link of type “INTEGRATED” for each configured PC-NET. This link type is used only by PC-NET process communication unit and it is created by the System Configuration Tool. The pc_net process is started when the LIN:B object of type “INTEGRATED” is created.

Node (NOD)

Nodes are directly or indirectly connected base systems and process communication units. The nodes are defined by NODn:B objects (n = 1 ... 250). A node definition is needed for:

- Communication to the communication units. Each process communication unit which is recognized by the base system must be defined as a node. These node definitions are described in Section .
- Reading and writing attributes. A node is primarily specified by the used connection link and the station address of the node. If a node is only indirectly connected to the base system, the link to the node is the link to the nearest intermediate node. The link object must have been defined before the node can be defined.

Node definition is also used to define another base system in a network. This is described in Section 3.7.2. Communicating between applications.

Example:

A process communication unit uses LAN link and is configured to be node 3 and its address is 203. The first step in the configuration is create a LIN:B object of type “LAN” (if not yet created for the base system communication). The link number is selectable in this situation. The next step is create NOD3: B object for the process communication unit and assign selected link number to the NOD3:BLI attribute of the created object. The node address 203 is assigned to the attribute NOD3:BSA.

This configuration must be present before the process communication unit in node 3 can be accessed. For more information, on system objects of type NOD and LIN, refer to ***System Objects manual***. The process communication unit is PC-NET and System Configuration Tool is used, these base system objects are created automatically, otherwise the NOD and LIN need to be created with SCIL. The example above would then require the following lines:

```
;LIN1:B OBJECT

#CREATE LIN:V=LIST(LT="LAN",-
TR="TCPIP")
#CREATE LIN1:B=%LIN

;NOD3:B OBJECT
#CREATE NOD:V=LIST(LI=1,-
SA=203)
#CREATE NOD3:B=%NOD
```

3.3.2. Configuring process communication units

The process communication unit types are:

- PC-NET
- OPC DA Client
- CDC-II Slave
- Modbus Slave
- Other CPI connected applications

Most of the communication protocols are supported by the PC-NET process communication unit. For more information on attribute PO and a complete list of protocols, refer to chapter NET lines for communication system in the System Objects manual. Communication unit of type OPC DA client is used with OPC connected protocols such as IEC61850. OPC DA client, CDC-II slave, Modbus slave and other CPI-connected applications. LAN link is used as the communication route between base system and the communication unit. The following chapters together with protocol specific manuals will describe the configuration details of each process communication unit type.

3.3.2.1. Configuring PC-NET

The recommended way to configure process communication unit of type PC-NET is to use System Configuration Tool. While creating the full configuration, it provides a set of possible selections in each step. In practise, these selections are mainly protocol specific line type and station types. The usage of the System Configuration Tool is described in Chapter Configuration tools. It is also possible not to use the System Configuration Tool and create the line and station configuration using SCIL. The protocol specific manuals contain examples of how this is done with each protocol. This method is often used when a MicroSCADA system is updated to a newer release and the amount of changes to the system is tried to minimize.

When the PC-NET program is started, it reads the initial configuration file PC_NET. CF1, which is a text file located in the SYS- directory. It defines the basic communication nodes and addresses to enable the communication to an application that downloads the total configuration.

When a PC-NET configuration is created with the System Configuration Tool, the tool produces two data files: sysconf.ini and signals.ini. When the system is started, it reads the mentioned files and creates a file “pc_net.cf1” automatically. To create system objects, the System Configuration Tool automatically creates the file sys_base.scl, which is executed at system start-up. After the PC-NET has started, the system executes the file sys_net.scl to configure the PC-NET. The file is automatically created by the System Configuration Tool. A step-by-step description of the System Configuration Tool operation is described in Section, PC-NET Startup with System Configuration Tool. This information is rarely needed, and in practise the system configuration can be entered and controlled without knowledge of the internal operation of the tool.

Startup definition file PC-NET.CF1

When PC-NET process starts, it always reads the start-up configuration file PC-NET.CF1. This file is generated automatically by the System Configuration Tool. If the configuration is loaded with SCIL, it may be necessary to edit this file. The following PC_NET.CF1 file is included in the MicroSCADA Pro delivery as a default configuration:

local_node.sa=203	The station address of the PC-NET.
local_node.nn=3	The node number of the PC-NET.
ext_node(1).sa=209	The station address of the base system.
ext_node(1).nn=9	The node number of the base system.
ext_apl(1).nn=9	The node number of the base system.
ext_apl(1).an=1	An application in the base system.

In case the PC_NET.CF1 file is missing when the PC-NET is started, a default configuration becomes valid.

PC-NET start-up with System Configuration Tool

The information given in this chapter describes the internal operation of the System Configuration Tool. Usually, this is transparent for the user.

The System Configuration Tool creates procedures for automatic start-up and configuration of the PC-NET. The automatic starting/configuration can be switched on or off. Manual starting/stopping of the PC-NET can be done in on-line mode. The automatic starting and configuration of the PC-NET works in the following way:

- A command procedure SYS_INIT_1:C is connected to the event channel APL_INIT_1:A as the first secondary object. If the list of the secondary objects is full, the last one is removed and a warning is generated (notify window, log file).
- The command procedure SYS_INIT_1:C calls a text file (StartPCNET.scl) which starts the PC-NET. The program in the text file first updates the sys_/pc_net.cf1 file and then starts the PC-NET by setting the corresponding base system link object type to "INTEGRATED". The pc_net.cf1 file is updated in the following way:

The PC-NET sends a system message to the own application when it is started. This message is received by a process object to which an event channel, SYS_NET'net_number'D:A, is connected. This event channel calls a command procedure SYS_NET'net_number'D:C. If the process object exists (for example created by LIB5xx) and has an event channel connected to it, all the objects connected to that event channel is moved to the SYS_NET'net_number'D:A event channel as secondary objects. In other cases, the System Configuration Tool automatically creates a process object SYS_NETD:P('net_number'), to which the event channel SYS_NET'net_number'D:A is connected.

The command procedure SYS_NET'net_number'D:C checks the message coming from the PC-NET. If this is the start message (10001), the PCNET is configured according to the information entered in the System Configuration Tool.

All the possible error messages that occur during the start-up or configuration of the PC-NET are shown in the notify window. They are logged into the SYS_ERROR. LOG and SYS_ERROR.OLD log files, which can be viewed in the System Configuration Tool.

PC-NET start-up with SCIL commands

A command procedure for on-line reconfiguration of PC-NET can be started as follows:

- When a PC-NET unit is restarted, it sends the system message 10001 to all the defined applications (by default to process object address 6000 + NET no.), provided that the application is running. The system message can be used for updating a process object which activates an event channel, which in turn starts a command procedure with reconfiguration commands. For more information describing the System messages from PC-NET units, refer to Section Sytem messages - base system configuration and Section, Sytem Messages - PC-NET configuration.
- When the connection between PC-NET and an application recovers after a break, PC-NET sends the system message 1000 + APL no. to the application (by default to address 6050 + NET no.). This message can be used for conditional start of reconfiguration procedures, that is, reconfiguration takes place if PC-NET has been restarted, not if the application has been out of use. This can be checked for example by reading a system object attribute configured on-line. If on-line configuration changes are valid, PC-NET has not been out of operation.

Reconfiguration commands could also, for example, be included in the command procedures started by the event channels APL_INIT_1 and APL_INIT_2, (APL_INIT_H in Hot Stand-by systems, refer to the ***Application Objects manual***). However, a PC-NET unit can be restarted even though the application is not restarted.

The protocol specific manuals contains examples for the configuration script for each protocol. In principle, following step are needed for every protocol:

1. Define the NET line to be used by assigning it the wanted protocol
2. Give the line its communication properties by means of the line attributes,
3. Create the station(s) by giving it an object number and assigning it the line number.
4. Set the attributes of the created object.
5. Take the line and the device into use.

In SCIL, communication system objects are created and deleted using NET attributes, refer to the System Objects manual. When adding a device, the NET line must first be defined. NET lines are defined by the NET line attribute PO. The used hardware device is generally defined with attribute SD which for example, may refer to certain serial port or PCLTA card.

Defining external nodes (NET)

All the connected base systems and communication units are defined as external nodes (NET objects). This applies also to base systems and communication units, which are only indirectly connected via other communication units.

The primary external node, that is, the PC-NET that communicates via integrated link is defined in PC_NET.CF1 file and the corresponding attribute values are updated . If there is a need to define other nodes, the configuration of NET node attribute NE need to be configured.

Defining applications (APL)

As a rule, all the applications in all base systems, which are directly or indirectly connected to the communication unit, must be defined to the NET unit as APL objects. The defined applications can be configured to receive spontaneous messages from the stations and system messages generated by NET.

In order to define or redefine an application in a connected base system:

1. Define an “Application”, an APL object, in the preconfiguration or on-line by means of the NETn:SSY attribute. For more information, refer to the ***System Object manual***.
2. Assign it to the following attributes for the communication supervision. For more information, refer to the ***System Object manual***.

From SCIL, the SW and SU attributes are accessed as NETn:S attributes.NET supervises all its application connections by cyclically reading the DS attribute of all known applications at the interval calculated from the SU attribute. If an application does not reply, an error message is produced and the application is suspended. This happens when the base system is closed, when the application has been set to "COLD", the application does not exist, or the connection is faulty or disturbed, or the communication does not work. When an application has been suspended, the S. P.I.D.E.R. RTUs connected to that application are not polled until the communication with the application has been re-established.

If the defined application is not running in a base system directly connected to the PC-NET but is running in another node, the NOD:B and LIN:B objects must define the route to the destination node. This route is usually a LAN link but this may also be a serial line ACP.

On-line configuration changes

The on-line configuration changes can be done in the on-line mode of the System Configuration Tool, with SCIL from a test dialog or from a command procedure.

The on-line changes take effect immediately. However, if the PC-NET unit is stopped and restarted, the on-line changes are lost and the preconfiguration is restored. On-line changes which need to be permanent, and are not made in the preconfiguration, should therefore be included in a command procedure which is executed each time the PC-NET unit is restarted.

When SCIL is used, the attributes are accessed with the object notation according to the format:

OBJnn:Sati

'nn'	Object number (device number)
'at'	Attribute name
'i'	The possible index

'OBJ' in this context may be 'STA' referring to a station object or 'PRI' referring to a printer object. For more detailed information about the object notation refer to the System Objects manual.

The attributes are written with the #SET command according to the format:

```
#SET OBJnn:SATi = value
```

The line attributes can be changed with the SCIL command #SET:

```
#SET NETnn:Sati = value
'i' Line number
```

For detailed information on each attribute, refer to the System Objects manual or protocol specific configuration manuals.

System messages - base system configuration

To use the system messages in an application:

1. Create a fictitious process object of type ANSI analog input and set the Unit Number (UN) attribute to 0. The system message codes of the device is registered as the object value of this object.
2. Set the objects Object Address (OA) attribute equal to the Message Identification (MI) attribute and set the Switch State (SS) attribute to Auto.
3. Select direct scale (1-1).

Define the consequential operations by using the event, alarm and printout attributes. For information on alarm generation, activation of event channel and automatic updating in pictures, for printout activation and for including event history in the event list, refer to the Application Objects manual.

The default values of MI attributes for each station type is presented in the System Object manual and in the protocol specific manuals. The defaults listed below are protocol independent:

Object	Message	MI default value
NET itself	General messages, for example start-up messages Value: status code	6000 + NET no.
	Application supervision Value: APL no.= failure 1000 + APL no. = recovery (APL no. as known to NET)	6050 + NET no.
NET line	All NET line messages	6000 + 100 NET no. + line no.

System messages - PC-NET configuration

When a system message is caused by a system object, it is directed to the application specified by the Message Application (MS) attribute of the object. The code of the message is updated as the object value for a fictitious process object with the Object Address (OA) attribute value equal to the value of the Message Identification (MI) attribute.

To achieve the system message handling in the communication unit:

1. Set the Message Application (MS) attribute of the system object to the number of the receiving application.
2. Set the Message Identification (MI) attribute of the system object to the value of object address of the receiving object. The MI attribute has object dependent default values which are also the recommended values, and should generally not be changed. The default value is used when the system object is defined on-line and the MI attribute is not explicitly set, or if the MI attribute is set to 0 in the preconfiguration. The default values are shown in a table of chapter 3.3.2.1.5, ***System Objects manual*** and protocol specific manuals.

The transmission of system messages from individual objects can be enabled or disabled by the System Message Enabled (SE) attribute of the objects. The system message generation should only be disabled in special cases, for example if the base system application program often executes commands which cause unwanted system messages.

The SE attribute exists for the PC-NET Node and it is accessed by NETx:SSE. This attribute controls the transmission of the system messages from all objects configured to the node. This attribute can also be used to enable the updating of the binary status points.

3.3.2.2. Configuring CDC-II Slave

CDC-II slave protocol is also supported by a separate executable which is connected to base system via LAN link. The configuration of the base system objects described in Section 3.3.1. Configuring communication system objects in base systemare needed before the communication between base system and the CDC-II slave executable is established. The required station type is “RTU”.

For a description of the configuration details of this process communication unit type, refer to ***CDC-II Slave Protocol User’s Guide***.

3.3.2.3. Configuring Modbus Slave

Like CDC-II, Modbus slave protocol is also supported by a separate executable which is connected to base system via LAN link. The configuration of the base system objects described in Section 3.3.1. Configuring communication system objects in base system are needed before the communication between base system and the modbus slave executable is established.

For description of the configuration details of this process communication unit type, refer to Modbus slave protocol Configuration manual.

3.3.2.4. Configuring CPI-connected applications

CPI (Communication programming interface) is a software library for connecting an application to the MicroSCADA basesystem. Each application instance using CPI as an interface is seen as node in MicroSCADA network and corresponding NODx:B and LINx:B need to be created.

For a description on how the CPI interface is used and how the application instance is seen from the base system, refer to ***Communication programming interface user's guide***.

3.3.2.5. Selected configuration examples for PC-NET

Base system network using serial ACP

Networks

For performance reasons, there should generally not be more than three communication units in a series between a base system and a communicating device - base system, workplace, printer or RTU.

When communication units and base systems are connected to a network, each NET unit and each base system in the network must be defined as a node in each other's NET unit and base system.

In order to connect two communication units through serial lines make the following definitions in each of the unit:

1. Select a line for the connection and define it with the ACP protocol as follows:

PO	1
MS	System message application
MI	System message object address
BR	Baud rate
PY	Parity
SB	Number of stop bits
RD	Read data bits
TD	Transmission data bits

ER	Embedded response
RE	Redundancy
TI	Time-out length in seconds (1 + 2400/BR)
NA	NAK limit
EN	ENQ limit
PS	Buffer pool size

The communication attributes (BR, and so on) should have the same values as the corresponding parameters in the connected communication unit. If the NET is a PC-NET, the line numbers 1...4 are available. These lines corresponds to the COM ports. When selecting one of these lines for the ACP protocol (setting the PO attribute of the line to 1), the line number cannot be used for any of the LON channels.

2. Define an "External node", a NET object, on the ACP line for the connected communication unit:

Device type	NOD
Device number	The node number of the connected communication unit
LI, Line number	The number of the selected line
SA	Station address of the connected communication unit

Though two communication units are connected indirectly via another unit, they must be defined to each other. Make the following definitions in each of the units.

3. Define an "External node" (NET object) connected to the line to the nearest communication unit:

Device type	OD
Device number	The node number of the indirectly connected communication unit
LI, Line number	The line to the nearest NET unit in the series
SA	Station address of the indirectly connected communication unit

Each NET unit which is connected to a base system via one or more other units (for example, NET unit 3 and base system 1 in Fig. 9.5.-1) must be defined to the base system as a node (NODn:B objects):

1. Create a NODn:B base system object corresponding to the indirectly connected communication unit. The NOD object number ('n') must be the same as the node number of the communication unit. The NOD object is given the following attribute values:

LI	Link number (= LIN object number)
	This is the link to the nearest communication unit
SA	Station address of the indirectly connected communication units

Even if there is no communication between the base system and the indirectly connected NET, the node definition is necessary for the system diagnostics, on-line configuration and system maintenance.

2. Define an "External node" (NET object) on the line to the nearest communication unit:

Device type	NOD
Device number	The node number of the indirectly connected base system
LI, Line numbe	The line to the nearest communication unit in the series
SA	Station address of the indirectly connected base system

3. Define an application for each application in the indirectly connected base system.

Fig. 3.3.2.5.-1 shows an example of a network of two communicating NETs and two base systems. The table below shows the configuration of the NETs and base systems. The example includes only the definitions which are of importance for this particular configuration and which have not been described in the previous sections.

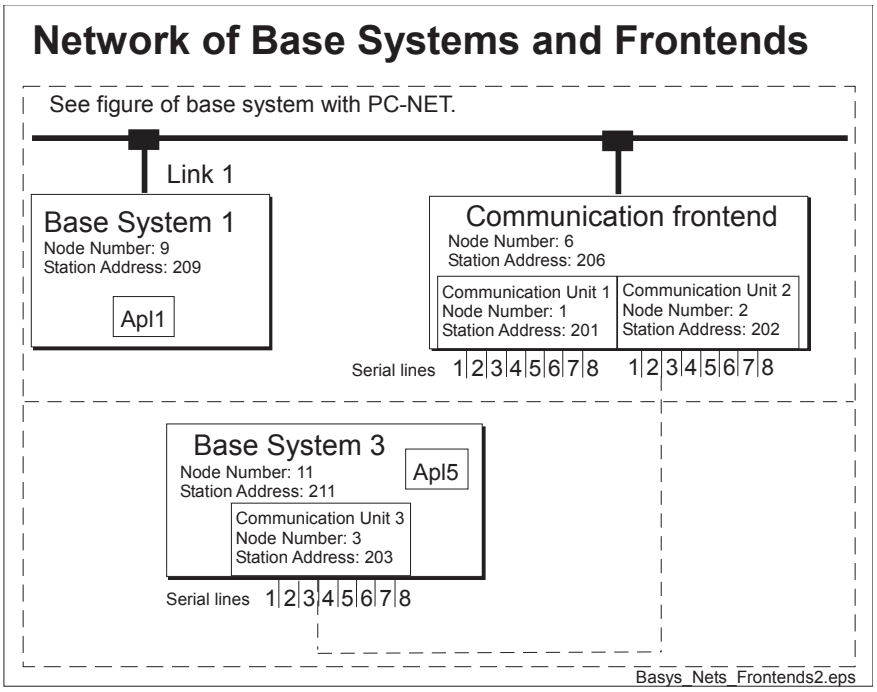

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Fig. 3.3.2.5.-1 Example of a configuration with interconnected base systems and NETs

Configuration of Communication unit 1		
See Fig. 3.3.2.5.-1.		
External node 9 (Base system 1)		
	Device type:	NOD
	Device number:	9
LI	Line number:	13
IU	In use:	1
SA	Station addr. (Dec.):	209
Application 1		
	Device type:	APL
	Device number:	1
	Translated APL number:	1
	Node number:	9

IU	In use:	1
SW	Reply timeout:	5
SU	Suspension time:	60
Configuration of Communication unit 2		
See Fig. 3.3.2.5.-1.		
Line 2 (ACP line)		
PO	Protocol:	1
IU	In use:	1
MS	Message application:	1
MI	Message ident.;	6202
LT	Link type:	1
BR	Baud rate:	9600
SB	Stop bits:	1
PY	Parity:	2
RD	Receiver data bits:	8
TD	Transm. data bits:	8
RE	Redundancy:	2
TI	Timeout length:	3
NA	NAK limit:	3
EN	ENQ limit:	3
ER	Embedded response:	1
RP	Reply poll count:	1
PS	Buffer pool size:	30
External node 3 (Communication unit 3)		
	Device type:	NOD
	Device number:	3
LI	Line number:	2
IU	In use:	1
SA	Station addr. (Dec.):	203
External node 9 (Base system 1)		
	Device type:	NOD
	Device number:	9
LI	Line number:	13
IU	In use:	1
SA	Station addr. (Dec.):	209
External node 11 (Base system 3)		
	Device type:	NOD
	Device number:	11
LI	Line number:	2
IU	In use:	1
SA	Station addr. (Dec.):	211
Application 1		
	Device type:	APL
	Device number:	1
	Translated APL number:	1
	Node number:	9

IU	In use:	1
SW	Reply timeout:	5
SU	Suspension time:	60
Application 5		
	Device type:	APL
	Device number:	5
	Translated APL number:	5
	Node number:	11
IU	In use:	1
SW	Reply timeout:	5
SU	Suspension time:	60
Configuration of Communication unit 3		
See Fig. 3.3.2.5.-1.		
Line 3 (ACP line)		
PO	Protocol:	1
IU	In use:	1
MS	Message application:	5
MI	Message ident.;	303
LT	Link type:	1
BR	Baud rate:	9600
SB	Stop bits:	1
PY	Parity:	2
RD	Receiver data bits:	8
TD	Transm. data bits:	8
RE	Redundancy:	2
TI	Timeout length:	3
NA	NAK limit:	3
EN	ENQ limit:	3
ER	Embedded response:	1
RP	Reply poll count:	1
PS	Buffer pool size:	30
External node 2 (Communication unit 2)		
	Device type:	NOD
	Device number:	2
LI	Line number:	3
IU	In use:	1
SA	Station addr. (Dec.):	202
External Node 9 (Base System 1)		
	Device type:	NOD
	Device number:	9
LI	Line number:	13
IU	In use:	1
SA	Station addr. (Dec.):	209
Application 1		
	Device type:	APL
	Device number:	1

	Translated APL number:	1
	Node number:	9
IU	In use:	1
SW	Reply timeout:	5
SU	Suspension time:	60
Application 5		
	Device type:	APL
	Device number:	5
	Translated APL number:	5
	Node number:	11
IU	In use:	1
SW	Reply timeout:	5
SU	Suspension time:	60

Configuring stations using RP570 master protocol

Base system configuration

In order to connect MicroSCADA network to RTUs with RP570 protocol, following definitions are required in the base system which uses the station:

1. Create a STAn:B object with the following attributes:

ND	The node number of the NET unit to which the RTU directly connected.
ST	RTU
TN	Corresponding STA object number in the communication unit.
TT	EXTERNAL

   For more information on the attributes, refer to the System Objects manual.

   The STAn:B object definition is not necessary, if the default station type defined by SYS:BDS is "RTU" and the default node defined by SYS:BDN is the NET unit to which the RTU is connected and the mapping is direct.

   However, if no STAn:B object is defined, the station cannot be handled by the MicroSCADA Pro tool pictures.

2. If needed, map the station for the application which uses it with the APLn:BST attribute. Station mapping is necessary only if the logical number is another than the STAn:B object number, which is the default mapping.

   The logical station number is the Unit Number (the UN attribute) of the process objects defined for the station. For more information, refer to the System Objects manual.

PC-NET configuration

Perform the configuration definitions described below in the NET unit to which the station is directly connected. It is assumed that the NET unit has been defined to the base system as a NODn:B object, and that the base system has been defined to the NET unit as an external node.

1. Select a line for the station (several RTUs can be connected to the same line) and define it with the RP 570 protocol:

PO	7
LT	0 (RS232) or 1 (modem line)
IU	1
MS	The application receiving system messages
MI	The object receiving system messages
BR	Baud rate, should be the same as in the RTU
PY	2
RD	8
TD	8
SB	1
PS	Buffer pool size
DE	CTS delay in milliseconds
EN	Enquiry limit time in milliseconds
PD	Poll delay in milliseconds
PP	Polling of suspended stations
RP	Number of consecutive polls
TI	Timeout length in seconds
HT	Timeout in milliseconds for start of response reception (default = 700 ms)
RI	Time delay in milliseconds before enabling a line after a message. Default = 0. A time delay must be used, if NET's transmission echoes back into the receiver.
RK	RTS keep up padding characters, refer to the *System Object manual*

2. Make sure that the application which receives spontaneous messages from the station (the station attribute AS) is defined as an APL object.
3. Define a station of type RTU connected to the RP 570 line:

Device type	4
LI	Selected line number
AL	1
AS	The number of the connected application
MS	The application receiving system message
MI	The object receiving system messages
SA	RP570 station address (= the address in the RTU)
RT	Reply timeout in seconds

If several stations are connected to the same line, define the stations with the same line number (LI).

The NET unit recognizes an automatically created "station", STA0, as "broadcast station". The broadcast station notates all S.P.I.D.E.R. RTUs connected to the same NET.

4. Synchronize the RTU200 clock with the clock of the NET unit at start-up by setting the SY attribute, for example #SET STAn:SSY (supposing that the NET clock has been synchronized before). By using the broadcast station number, all RTUs connected to one NET can be synchronized simultaneously.
5. If needed, change the AW attribute of the RP 570 line (refer to the System Objects manual). This is normally not necessary.

A MicroSCADA Pro revision beginning with 8.2B supports the configuration of hierarchical RTU structures. Define the sub-RTUs as STA objects in NET and in the base system, in the same way as an RTU connected directly to NET as described in the manual. The only difference between the directly connected RTUs and sub-RTUs is the STAn:SHR attribute, refer to the System Objects manual. For STA objects corresponding to sub-RTUs, the HR attribute is the station address of the RTU one level above in the hierarchy.

The data of ERMFD and ERMIR telegrams is converted into bit stream values, which are sent to the process database.

In order to register the data in the process database, define bit stream type process objects with the following object addresses:

For ERMFD : 2304 + block nr

For ERMIR : 1792 + block nr

ERMFD data coding in process object

Bit stream object value:

bytes 1..4:	VALUE (least significant byte first)
byte 5 :	STATUS with time quality and so on, copied from RP 570 telegram
bytes 6..7:	RELATIVE TIME (least significant byte first)
bytes 8..9:	NUMBER (least significant byte first)
byte 10:	CAUSE OF TRANSMISSION
byte 11:	FORMAT
Registration time: stored in RT attribute as normal	

ERMIR data coding in process object

Bit stream object value:

byte 1:	VALUE (least significant byte first)
byte 2 :	BIT NUMBER
byte 3 :	INDICATION TYPE
byte 4 :	STATUS with time quality and so on, copied from RP 570 telegram
bytes 5..6 :	RELATIVE TIME (least significant byte first)
bytes 7..8 :	NUMBER (least significant byte first)
byte 9 :	CAUSE OF TRANSMISSION
Registration time: stored in RT attribute as normal	

The coding of each field, when not explicitly described above, follows the RP 570 telegram.

There are two methods of building an RTU configuration. The RTU configuration can be performed independently of MicroSCADA Pro, which means that the MicroSCADA Pro process object definition is built separately with no help from the RTU configuration files. Alternatively, the RTU configuration can be built via MicroSCADA Pro, which means that the MicroSCADA Pro engineer can use the configuration in the process object definitions. Changes in the MicroSCADA Pro process database can then be loaded down to the RTUs.

RTU configuration

It is recommended to build the RTU configuration via MicroSCADA Pro. The following steps are included :

- Using the EDU (Engineering and Diagnostic Unit) tool, that is the RTU configuration tool for RTU engineering. The RTU configuration is stored in key files. When using EDU, a file conversion is required.
- Defining the process database objects in the MicroSCADA Pro system using the key files.
- Loading down the complete configuration to the RTU, including possible changes made in the MicroSCADA Pro process database.

Loading the RTU configuration

If your RTU is connected, you can now load the configuration, or you can use the process definition tool to make changes in the definitions.

1. Select **Other Choices**.
2. Select **Download**.
3. Click **Start** to start the loading.

Configuring stations using ANSI X3.28 protocol

Base system configuration

Connecting a station using the ANSI X3.28 protocol (ANSI station) to the MicroSCADA Pro network requires the following definitions in the base system which uses the station:

Create a STAn:B (n = 1 ... 2047) object with the following attributes:

ND	The node number of the NET unit to which the station is directly connected.
ST	"STA"
TN	STA object number in the NET unit.
TT	"EXTERNAL"

The STAn:B object definition is not necessary if the default station type, defined by SYS:BDS, is "STA" and the default node, defined by SYS:BDN, is the NET unit to which the station is connected to and if the mapping is direct.

If needed, map the station to the application which uses it with the APLn:BST attribute. Station mapping is necessary only if the logical number is other than the STAn:B object number, which is the default mapping. The logical station number is the Unit Number (the UN attribute) of the process objects defined for the station (refer to the System Objects manual).

Configuration for SRIO device

SRIO system parameters

By changing the SRIO 1000M system parameter values, the application programmer can affect general features of the SRIO 1000M program. The system parameters are located in the address area from 3000 upwards.

Table 3.3.2.5.-1 shows some examples of system parameters, each of which occupies one word. For further information about SRIO system parameters, refer to the SRIO manuals.

Table 3.3.2.5.-1 Examples of systems parameters

Word 0 (address 3001): Spontaneous event data transmission	
	1 = Enabled
	0 = Disabled
Word 1 (address 3002): Spontaneous transmission of changed data in database	
	1 = Enabled
	0 = Disabled
Word 2 (address 3003): Store command	
	1 = Start storing the configuration data into EEROM
	0 = No meaning
Word 3 (address 3004): Analog data format	
	0 = 32 bit integer
	1 = 3-digit BCD
	2 = 6-digit BCD
Word 4 (address 3005): Analog data scaling	
	1, 10, 100, 1000 (default) or 10000
Word 5 (address 3006): Time polling interval	
	30 .. 30000 seconds (default = 60 s)

Example:

```
#SET STA1:SME3001=0
```

Disable spontaneous process data transmission.

```
#SET STA1:SME3002=1
```

Store SRIO 1000M configuration data into EEROM memory.

```
#SET STA1:SME3003=1
```

Analog values to be coded as 3-digit BCD numbers.

SRIO object parameters

The SRIO object parameters allow the MicroSCADA Pro applications to read and write the definitions of data items, data groups and event data polling.

The start address of object parameters is 5000 in the default configuration. SRIO can contain up to 500 objects.

The following attributes are defined for each data item (start address refers to the start address within the object parameter area, that is add 5000 to each address):

Attributes	Start address
ANSI address	0
Bus number	500
SPACOM address	1500
Data type/format	4500
Delta value/bit mask (32 bits)	5500
Status word (16 bits)	6500

Example

A SCIL command procedure for the creation of an AI type SRIO object:

Defining variables

```
@OBJ_IND  = Object nr (index) in the SRIO database
@ANSI_A   = Object address in the MIcroSCADA database
@BUS      = Bus number
@SPA_A    = SPA address as a 6 word vector (see the SRIO manuals)
@DTYPE    = Data type
@DFORM    = Data format
@DELTA    = Delta value
@STATUS   = Status word as an integer
```

Defining constants

```
@OB_PAR_I  = 5000
@ANSI_A_I  = %OB_PAR_I
@BUS_I     = %OB_PAR_I + 500
@SPA_A_I   = %OB_PAR_I + 1500
@DATA_T_F_I = %OB_PAR_I + 4500
@DELTA_I   = %OB_PAR_I + 5500
@STATUS_I  = %OB_PAR_I + 6500
```

Creating object

```
#SET STA1:SME (%ANSI_A_I+%OBJ_IND) = %ANSI_A
#SET STA1:SME (%BUS_I+%OBJ_IND) = %BUS
@SPA_STADR =  %SPA_A_I + 6 * %OBJ_IND
#SET STA1:SME (%SPA_STADR..(%SPA_STADR+5)) = %SPA_A
```

```
@D_T_F_ADR = %DATA_T_F_I + 2 * %OBJ_IND
@DATA_T_F(1) = %DTYPE
@DATA_T_F(2) = %DFORM
#SET STA1:SME (%D_T_F_ADR..(%D_T_F_ADR + 1))=%DATA_T_F (1..2)
@DELTA_S_A = %DELTA_I + 2 * %OBJ_IND   ;32-BIT ADDRESS
#SET STA1:SME (%DELTA_S_A) = %DELTA
#SET STA1:SME (%STATUS_I+%OBJ_IND) = %STATUS
```

A data group can consist of 10 data items, and there can be up to 100 data groups. The data group definition tells the ordinal numbers of the data items in the group. The data group definitions are found from the address (7000 + object parameter area start address). Above is an example of a SCIL command procedure which defines a data group.

The event data polling can cotain up to 300 SPA bus slave units (100 slaves/bus). In the address range starting from 8000 + object parameter area start address. The following features of each object to be event polled are defined:

- Bus number
- Unit number
- Unit type
- Status

Examples of creating a SRIO data group with SCIL

Defining variables

```
@GROUPNR  = Number of the group to be created
@MEMBERS  = Vector containing the ordinal numbers of the group members
        in the SRIO 1000M database.
```

Defining constants

```
@GROUPDEFSA = 12000
@GROUPLEN  = 10
```

Creating the data group

```
@MEMBCOUNT = LENGTH (%MEMBERS)
@STARTADR = %GROUPDEFSA + %GROUPNR * %GROUPLEN
@ENDADR = @STARTADR + %MEMBCOUNT - 1
#SET STA1:SME (%STARTADR..%ENDADR) = %MEMBERS
```

Auto-dialling in serial protocols

Auto-dialing can be used on all NET serial lines with the following protocols:

- ANSI X3.28 Half Duplex or Full Duplex protocols,
- ACP (Application Communication Protocol)
- Modbus
- Alpha
- IEC 61107
- RP 570 master and slave
- SPA
- IEC 60870-5-101 master and slave
- IEC 60870-5-103 master
- DNP 3.0 master and slave

The example below describes the configuration using SCIL. The usage of the System Configuration Tool is possible and recommended.

Auto-dialling is useful for example:

Auto-dialling can be used on all NET serial lines defined for the ANSI X3.28 Half Duplex or Full Duplex protocols, ACP (MicroPROTOCOL), Modbus, IEC 61107 or the RP 570 protocol. Auto-dialling is useful for example:

- For the connection of remote stations with infrequent data transfer
- For the connection of home terminals
- For taking a reserve line into use

Auto-dialling is possible in both directions.

The auto-dialling line can be defined in the preconfiguration. However, the auto-dialling feature cannot be preconfigured, it must be configured and taken into use on-line.

Create the line in the preconfiguration or on-line. Depending on the device(s) connected to the line, set the Protocol (PO) attribute to 1 for the ANSI X3.28 Full Duplex protocol, 2 for the ANSI X3.28 Half Duplex protocol, 25 for Modbus RTU mode master protocol and 26 for the IEC 61107 protocol.

The auto-dialling feature for a line can be added by using a tool or SCIL. The dial-up modem has to be connected to the line while defining the auto-dialling feature.

To define the auto-dialling with SCIL:

1. Take the line out of use by setting the In Use (IU) attribute of the line to 0, for example:

   ```
   #SET NET1:SIU5 = 0
   ```

2. Set the ACE (AC) attribute of the line to 1, for example:

   ```
   #SET NET1:SAC5 = 1
   ```

3. If the NET unit is supposed to answer incoming calls which is always the case on RP 570 lines, set the Remote Calls Enabled (RC) attribute to 1, for example:

   ```
   #SET NET1:SRC5 = 1
   ```

4. If an automatic break of the connection is wanted after a specified time, set the Connection Time Limited (CL) and Connection Time (CT) attributes, for example:

   ```
   #SET NET1:SCL5 = 1
   ```

   ```
   #SET NET1:SCT5 = 500
   ```

   which means that the connection is broken automatically after 500 seconds.

5. If needed, set the Radio Disconnection Delay (DD), Pulse Dialling (PU), Radio Connection Wait Time (RW) and ACE AT S Register (SR) attributes. Refer to the System Objects manual.
6. Set the In Use (IU) attribute of the line to 1, for example:

```
#SET NET1:SIU5 = 1
```

To dial up a workplace or RTU from a NET:

Set the Connection (CN) attribute in an application program as follows:

```
#SET NETn:SCNline = "phone"
```

or when dialling a station:

```
#SET NETn:SCNline = "phoneSstation"
```

where

line	Line number
phone	Phone number of the receiver
station	Station number of the receiver

Dialling is done while the line is in use (IU = 1).

When the NET is dialling, system messages with codes 16107, 16208 or 16825 (depending on the protocol) are generated. If a station is dialling, the codes 16108, 16209 or 16826 are generated. A failed dial-up generates the code 16704.

The connection to an RTU is broken automatically, under following circumstances:

- RTU becomes inoperable
- RTU hangs up
- when the RTU is the dialling part
- RTU has nothing to send (after two subsequent CCR2 responses)

In addition to these, the connection can be broken automatically according to the Connection Time (CT) attribute. If the connection is not broken automatically, break it by setting the Connection (CN) attribute to 0:

```
#SET NETn:SCNline = 0
```

A succeeded hang-up generates a system message with code 16733. If the hang-up failed, the code 16702 or 16703 is generated. The status codes 16106, 16107 and 16810 indicate that disconnection has started.

Example:

Dialling a MicroTERMINAL:

```
#SET NET1:SCN5 = "1234567"
```

Dialling station 11 (STA11):

```
#SET NET1:SCN5 = "1234567S11"
```

Breaking the connection:

```
#SET NET1:SCN5 = ""
```

3.3.3. Distributed process communication units

In principle, the process communication unit may be directly connected to any base system node in MicroSCADA Pro network. The application containing the corresponding process database may be in another base system node and all data sent from the process communication unit is transmitted through the LIN objects between these nodes. The used protocol is ACP (Application Communication Protocol). The base system between the process communication unit and the upper base system routes the ACP messages in both directions. The STAn:B objects are created to both to the routing base system and to the base system running the database.

A commonly used system setup is based on the distribution of PC-NET process communication unit to separate computers. In this configuration, the primary link between the base systems is a LAN link. For more information on this configuration, refer to Section Distributed PC-NETs.

If the process communication unit is configured to contain slave protocols, in general it is recommended that the unit is directly connected to the base system which contains the base system. In other words, it is not recommended that for example the COM500i application refers to STAn:S objects running in another computer.

3.3.3.1. Distributed PC-NETs

There are many reasons why it is necessary to divide the PC_NETs to operate in a separate computer or multiple separate computers:

- Computer hardware limitations of LON or serial cards
- Decreasing the problems caused by a computer failure
- Process communication causes CPU load
- Redundancy is required in the process communication level

The base system which is directly connected to the PC-NET usually contains no process database. Following picture presents the system containing a hot-stand-by base system containing a process database and three separate computers for process communication. In the system, the CPU load caused by the process communication is divided to three CPUs. Furthermore, if a hardware failure occurs in some of the computers, the rest of the system is still under control.

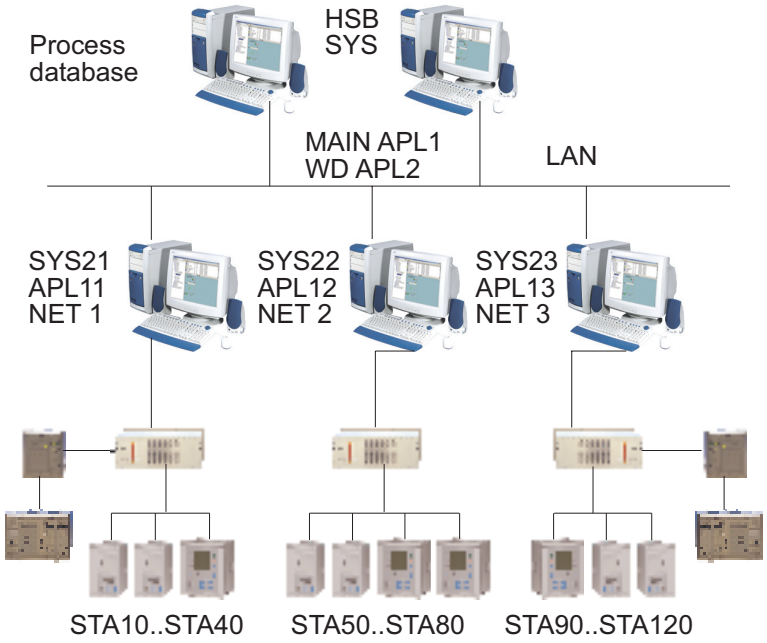


Fig. 3.3.3.1.-1 PC_NET configuration

The “light” base systems SYS21..SYS23 running APL11..APL13 only routes the ACP messages between PC_NET nodes and APL1. In the system start-up or in the hot-stand-by switch the APL1 is defined to be in either of the basesystems containing the database.

The picture above describes a situation in which there is only one PC-NET running in each computer. In practise, each of these computers may contain multiple PC-NET instances and various set of lines using different protocols. Furthermore, each of these computed may also be doubled using hot-stand-by configuration. The watchdog APL object needed in hot-stand-by configuration is APL2.

At the process database level, the system may also contain mirroring. For more information about hot-stand-by redundancy and mirroring issues, refer to Section 3.8.1. Hot stand-by base systems and Section 3.9. Configuring mirroring.

The system configuration tool should be used in each of the computers running the PC-NETs. The corresponding STAn:B objects must be configured to the base systems containing the process database. The selected part from the SYS_BASCON.HSB file (described in Section 3.8. Configuring redundancy) for the system described above would be:

```
.
.
@BS_NODES = (9,10, 21, 22, 23)   ;BASE SYSTEM NODES
@FE_NODES = (1,2,3)   ;FRONT-END NODES
@FE_NODE_LINKS = (1,1,1)   ;LINK NUMBER OF FE NODES
.
.
;FE_NOD_BEGIN
#CREATE NOD:V     ;FRONT-END NODE
#LOOP_WITH I = 1 .. LENGTH(%FE_NODES)
  #SET NOD:VLI = %FE_NODE_LINKS(%I) ;LINK NUMBER
  @NODE = %FE_NODES(%I)
  #SET NOD:VSA = 200 + %NODE ;STATION ADDRESS
  #CREATE NOD' NODE' :B = %NOD
```

```
#LOOP_END
;FE_NOD_END

;BS_NOD_BEGIN
#CREATE NOD:V ;BASE SYSTEM NODE
#SET NOD:VLI = 1 ;LINK NUMBER
#LOOP_WITH I = 1 .. LENGTH(%BS_NODES)
   @NODE = %BS_NODES(%I)
   #SET NOD:VSA = 200 + %NODE ;STATION ADDRESS
   #SET NOD:VNN = %SYSTEMS(%I)
   #CREATE NOD' NODE' :B = %NOD
#LOOP_END
;BS_NOD_END


;STA_BEGIN Create STAn:B objects


@STA_NOD = %FE_NODES(1)   ;NODE OF STAS 10..40


#CREATE STA:V = LIST(-
ND=%STA_NOD,-
ST="LMK",-
TT="EXTERNAL")
#CREATE STA10:B=%STA

#CREATE STA:V = LIST(-
ND=%STA_NOD,-
ST="SPA",-
TT="EXTERNAL")
#CREATE STA11:B=%STA


#CREATE STA:V = LIST(-
ND=%STA_NOD,-
ST="REX",-
TT="EXTERNAL")

#LOOP_WITH I = 12 .. 40
  #SET STA:VTN=%I
  #CREATE STA' I' :B=%STA
#LOOP_END

@STA_NOD = %FE_NODES(2)   ;NODE OF STAS 50..80
.
.
.
```

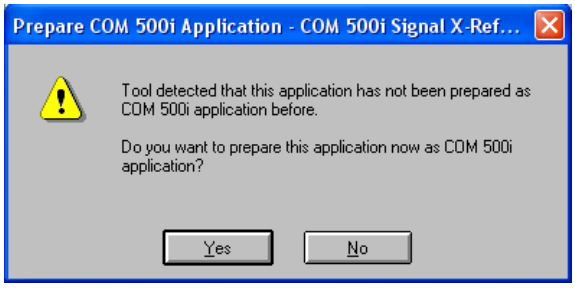
The definition file above will create NOD:B objects for basesystems and PC-NET nodes. After this, the STAn:B objects are created for each station object created to the PC-NET nodes. This configuration must match with the configurations entered with System Configuration Tool.

When a hot-standby switch, that is, “take-over” occurs during run-time, the main application changes to “HOT” state in the adjacent base system. In this situation , a procedure SHADMAPNET is executed and PC-NET nodes are informed that the application is running in another base system node. The used attribute is NET node attribute SY. For more information about the hot-stand-by configuration and the run-time operation, refer to Section 3.8.1. Hot stand-by base systems.

3.4. Configuring communication gateway

Before the gateway engineering can start, the application has to be prepared for the gateway functionality. This is done in the Signal X-Reference Tool as shown in Fig. 3.4.-1. Once the application is prepared, it should be restarted, as shown in Fig. 3.4.-2. After restarting of the application, COM 500i creates all the necessary

application objects, such as event and time channels, and command procedures are created automatically, also the directory\sc\apl\ <name> \com500 that is used for storing cross-reference files and parameter files.


Prepare COM 500i Application - COM 500i Signal X-Ref...
Tool detected that this application has not been prepared as COM 500i application before.
Do you want to prepare this application now as COM 500i application?
Yes
No

A070466

Fig. 3.4.-1 Prepare COM 500i Application

Prepare COM 500i Application - COM 500i Signal X-Ref...
Application was prepared successfully as COM 500i application.
Application restart is required to apply this change into application.
OK

A070467

Fig. 3.4.-2 Application prepared successfully

3.4.1. SYS_BASCON.com modifications

Command procedures of COM 500i use parallel queues and comment marks. (-; characters) must be removed from the beginning of PQ and QD attribute lines in SYS_BASCON.com file

Application definition for gateway:

```
#CREATE APL:V = LIST(-
   TT = "LOCAL",-    ;Translation Type
   NA = "TUTOR",-    ;Name of application directory
   AS = "HOT",-     ;Application state (COLD,WARM,HOT)
   PH = %l_Global_Paths,-
   PQ = 16,-                  ;Number of parallel queues/ Needed in COM500 Applications
   QD = (1,1,0,0,0,0,1,1,1,1,1,1,1,1,1,1),- ;Parallel queue dedication/ Needed in
COM500 Applications
   SV = %SV,-       ;System variable (RESERVED)
   CP = "SHARED",-   ;Color Allocation Policy
-;   RC = VECTOR("FILE_FUNCTIONS_CREATE_DIRECTORIES"),- ;Revision compatibility
   HP = "DATABASE",-  ;History Logging Policy ("DATABASE", "EVENT_LOG", "NONE")
   EE = 1,-        ;System Events  Operating System Events (1=Enabled, 0=Disabled)
   AA = 1,-        ;Number of APL-APL servers
   MO = %MON_MAP,-   ;Monitor mapping
   PR = (1,2,3))     ;Printer mapping
#CREATE APL1:B = %APL
```

3.4.2. Gateway license

The gateway functionality can be used, if the value in the gateway field is non zero. The value also tells, how many NCC line can be configured in Signal-X Reference.

Fig. 3.4.2.-1 Gateway license

3.5. Configuring peripheral equipment

Following devices have connection from MicroSCADA (are defined in sys_bascom.com):

- Printers
- I/O cards (Adaptech 1760, Nudaq 7250 and 7256)
- Meinberg clock cards

3.5.1. Configuring printers

To connect a printer directly to a base system computer, follow the instructions given below:

1. Connect the printer to a parallel or serial port. Printers connected to the parallel port of a base system computer can be placed at a maximum 3 metres from the base system computer. Serial lines allow the connection lines to be up to 15 meters without modem.
2. Configure the printer to the operating system as described in the Windows manuals. Define the printer as “shared” if it is going to be used by several base systems or other Windows computers on the LAN.
3. Select the connection mode on the printer.
   - Select parallel mode if the printer is connected to the parallel port.
   - Select serial mode if it is connected to a serial port.
4. Configure the printer in the base system as a PRIn:B object. If the printer is used by several base systems, or by programs other than MicroSCADA Pro on the same or other computers, set the printer's OJ attribute to 1.

Printers that is used by several base systems must be defined in all base systems, both regarding the operating system configuration and the MicroSCADA Pro configuration.

Connecting printers to LAN

Printers connected to a base system computer or LAN must be configured in all base systems that will use the printers.

Connecting printers to PC-NET units

To connect a printer to a unit, follow the instructions given below:

1. Connect the printer to a free line. The lines with the lowest priority is preferable for printer connections.
2. Select the serial mode for connection mode on the printer.

3. Define the printer line and a PC-NET PRI object to which it is directly connected.
4. Define the printer as a PRI object in the base systems which are using it.

A printer, connected to a NET, can be used by all base systems connected to the same network of frontends. The printer must be defined both in the base systems which will use it and in the NET unit to which it is directly connected.

3.5.2. Configuring I/O adapter cards

I/O signals can be used for external alarm output and input indications.

I/O cards supported are ADLink NuDaQ PCI-7250, PCI-7256 or Advantech PCI-1760 Alarm panel: Supplied by ABB Distribution Automation, Finland.

Alarm panel include seven led indicators, one for each alarm class, watchdog alarm indicator, buzzer for audio alarm (can be switched off by using jumper), quit button for alarm leds and connector for external alarm reissuing. On input side there are two parallel connections, which enable two systems to drive one alarm panel.

MicroSCADA support two different I/O cards. Both the cards require own connection cable for alarm panel. Card end of cable is D37(mail) and the other end D25 (mail).

To run external horns, robot phones or other equipment, alarm panel include relay output. Functionality is parallel to alarm panel indicators. Alarm outputs (excluding watchdog) are available also without alarm panel. Driver programs are from card manufactures. SYS object AA is used in MicroSCADA configuration.

Signal available from I/O cards and cable wiring for ABB Alarm Unit. Connector (D25 female), relay outputs ACx = Alarm Class x:

Table 3.5.2.-1 Signals from I/O cards

Connector (D25 female)	Relay outputs ACx = Alarm Class x
1	AC1
2	AC1
3	AC2
4	AC2
5	AC3
6	AC3
7	AC4
8	AC4
9	AC5
10	AC5
11	AC6
12	AC6
13	AC7
14	AC7

Table 3.5.2.-1 Signals from I/O cards (Continued)

Connector (D25 female)	Relay outputs ACx = Alarm Class x
15	ALARM QUIT (INPUT -)
16	ALARM QUIT (INPUT +)
17	WATCHDOG
18	WATCHDOG
19	
20	
21	
22	
23	
24	
25	

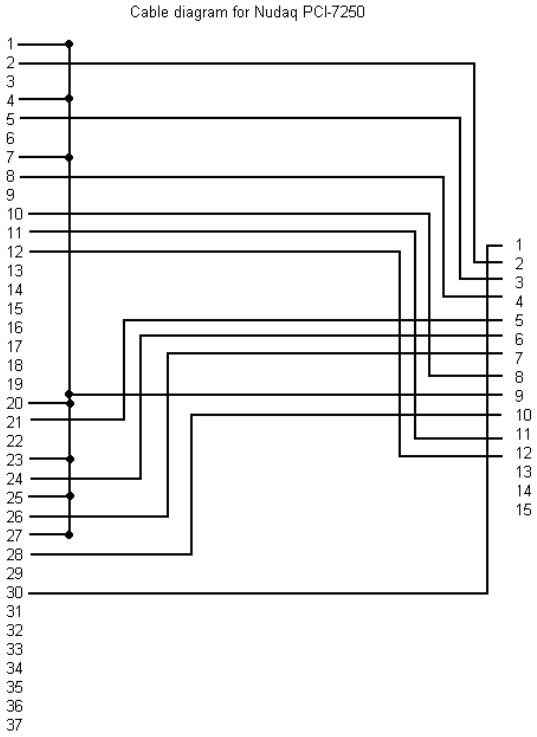


Fig. 3.5.2.-1 Cable diagram for Nudaq

For more information about the Advantech PCI-1760 and ADLink PCI-7250 and PCI7256 I/O driver installation and configuration, refer to the equivalent card manufacturer documentation. The Windows drivers for PCI cards are delivered with the cards.

The driver versions supported by MicroSCADA Pro are:

- Version 2.0 of the ADLink's PCI-7250 I/O card driver for Windows.
- Version 1.10 of the Advantech's PCI-1760 I/O card driver for Windows.

The supported versions of the drivers are available in the following websites:

- ADLink website: http://www.adlink.com.tw/home.htm
- Advantech website: http://www.advantech.com/

3.6. Configuring time handling

In general, the time synchronization of the MicroSCADA Pro system and connected IEDs is necessary in order to interpret correctly any time-stamped information provided by the system. The time-stamped information can be, for example, the event information from the IEDs.

The MicroSCADA Pro system uses the internal clock of the computer as the source of time. Depending on the configuration and the system structure, this clock may be synchronized from an external source such as GPS, radio clock or another MicroSCADA Pro system. The GPS clock reference device is connected through a SLCM card via a LON line or using an external application. When the MicroSCADA Prosystem is operating as a communication gateway, the synchronization is often received from the network control center through the used communication line.

The same internal clock is used, when the real IEDs connected to the MicroSCADA Pro system are synchronized through the communication lines in process communication units. In most of the communication protocols there is a predefined method to synchronize the IED. For more information about the synchronizing methods, refer to the protocol-specific manuals. When MicroSCADA is used to synchronize the IED, the synchronization command is usually initiated cyclically from the application running in the base system. The related station object attribute is SY for many protocols. In some protocols there is a possibility for the IED to request a time synchronization from the master.

The process communication units running in the same computer use the same system clock which means that there is no need to make separate synchronization for the unit. This is different from the DCP-NET units used with the older MicroSCADA versions, where the units had a separate clock in the used hardware.

When operating as a communication gateway the network control center may operate in a different time zone. The corresponding compensation attribute is TZ which exists both in SYS:B object and NET:S object (only for process communication unit PC_NET).

3.6.1. Configuring time synchronization

The time synchronization characteristics usually vary from one system to another and are strongly dependent on customer and/or IED requirements. The communication protocol used, also has an effect. For example, with SPA-protocol the time synchronization command is sent every second. With some other protocol, the interval of the time synchronization may be hours.

Following steps should be considered when the time synchronization concept for a MicroSCADA system is planned:

1. Find out the system requirements
2. Resolve the clock reference for the planned system
3. Resolve IED requirements with the used communication protocol
4. Define the synchronization intervals for IEDs or IED groups
5. Define the time synchronization details of the used protocol

In step 2 it is defined if the clock of the MicroSCADA computer is synchronized from an external source. This source could be a network control center or a radio clock device connected to a communication line in PC_NET, an external application using SNTP server and/or GPS device, a SLCM-card connected to LON star coupler and so on.

If the source of the time is connected to communication line of the PC_NET, some configurations tasks may be required. For general ASCII protocol, refer to Section 3.6.1.1. Configuring external clocks. For IEC60870-5-101/104 and DNP3.0 protocols, refer to corresponding slave protocol manuals, station attribute TC. For LON protocol, refer to System Objects manual, line attribute LK. The time zone compensation is done with attribute SYS:BTZ.

If the source of the time is an external application or a special device, see corresponding manuals for more information.

In step 3 the requirements of the used IEDs are defined. These requirements may define the minimum frequency of the incoming time synchronization or it may require that the synchronization must be preceeded by a delay measurement. The IED may also define if it accepts the time only with or without date or only as a broadcast message. It is also possible to synchronize the device from an external time source and it need not be done from MicroSCADA at all.

Steps 4 and 5 will require MicroSCADA application programming. With protocols implemented to process communication unit PC-NET, a common practice is to define a time channel or a set of time channels which are executed with a defined interval. A command procedure which actually initiates the synchronization is then connected to the time channel.

Example:

Example for DNP3.0 master protocol:

```
#LOOP_WITH I=20..25
    #IF STA'I':SIU==1 AND STA'I':SOS==0 #THEN #BLOCK
     #SET STA'I':SSY=(1,0)  ; direct, no time delay measurement
     #PAUSE 10
    #BLOCK_END
   #LOOP_END
```

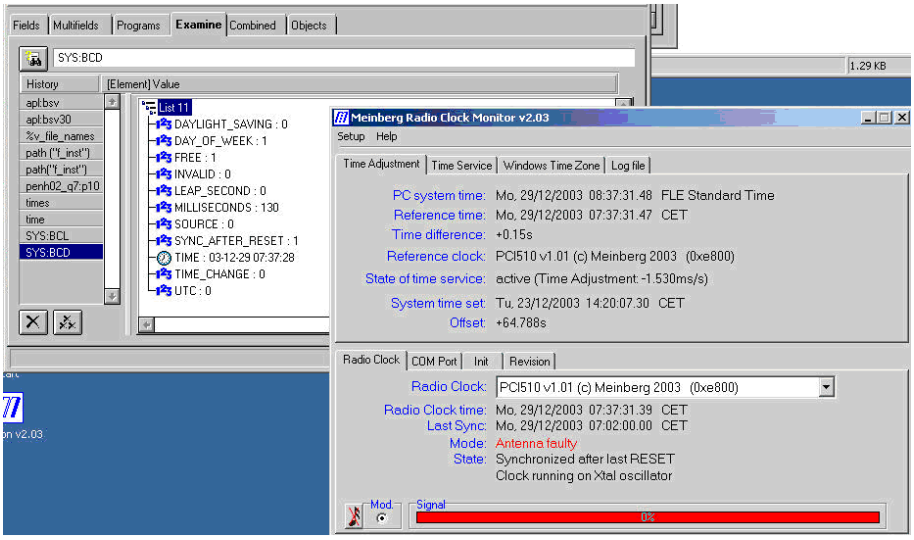
If this procedure is attached to an event channel which is executed with 1 hour interval, the IEDs related to STA20..STA25 are synchronized once every hour. The same station object attribute SY is used for time synchronization in most protocols implemented to PC_NET. For more details, refer to protocol-specific manuals and System Objects manual.

3.6.1.1. Configuring external clocks

DCF77 radio clock from Meinberg

The board PCI511 has been designed for the reception of the DCF77 signal, the transfer of the time information to a computer with PCI (PCI-X) bus interface. Install the card to a free PCI bus card place. After switching on, it will ask to locate the place of the driver software.

The drivers package contains a monitor program, which allows the user to check the status of the device. It is also useful to modify parameter configuration.



A070709

Fig. 3.6.1.1.-1 Configuring Meinberg radio clock

3.7. Configuring networks

Each NET unit, which is connected to a base system via one or more than one units, must be defined to the base system as a node (NODn:B objects):

1. Create a NODn:B base system object corresponding to the indirectly connected communication unit. The NOD object number ('n') must be the same as the node number of the communication unit. The NOD object is given the following attribute values:

   LI = Link number (= LIN object number). This is the link to the nearest communication unit

   SA = Station address of the indirectly connected communication units

   Even if there is no communication between the base system and the indirectly connected NET, the node definition is necessary for the system diagnostics, online configuration and system maintenance.

   Correspondingly, each base system connected to a NET unit indirectly via other units must be defined to the NET unit as a node.

2. Define an "External node" (NET object) on the line to the nearest communication unit:

   Device type = NOD

   Device number = The node number of the indirectly connected base system

   LI, Line number = The line to the nearest communication unit in the series

   SA = Station address of the indirectly connected base system

3. Define an application for each application in the indirectly connected base system.

   Example:

   Fig. 3.7.-1 shows an example of a network of two base systems and a Frontend system containing two communication units. Application 1 communicate to process true Frontend system, and APL1 and APL5 (in Base system2) communicate with each other.

   The example includes only the definitions which are of importance for this particular configuration.

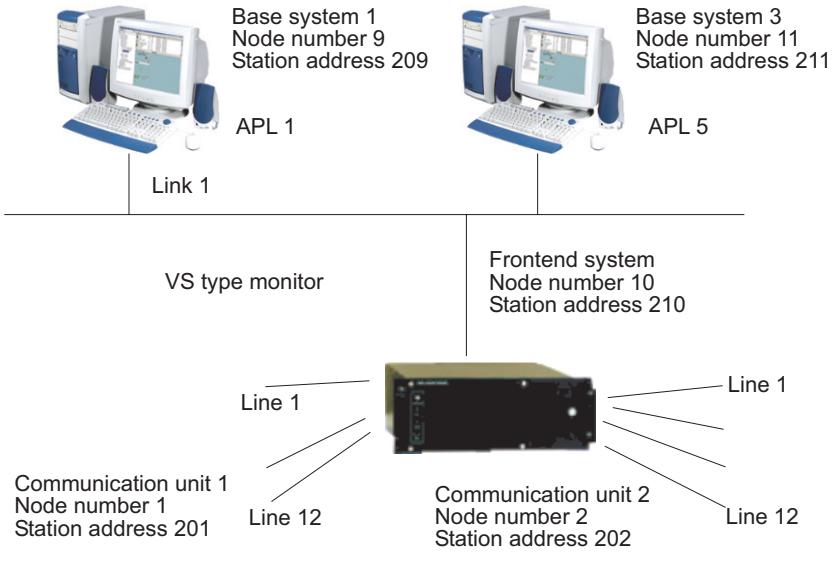


Fig. 3.7.-1 Network of two base systems and a Frontend system containing two communication units

Configuring base system 1

```
Link 1 (LAN link):
#CREATE LIN:V = LIST(LT = "LAN",-
#CREATE LIN1:B = %LIN
.....
Node 1 and 2
(Communication units 1 and 2):
.....
#CREATE NOD:V = LIST(LI = 1,-
  RN = 10,-
  SA = 201)
```

```
#CREATE NOD1:B = %NOD
…….
#CREATE NOD:V = LIST(LI = 1,-
  RN = 10,-
  SA = 202)
#CREATE NOD2:B = %NOD
…….
Node for Base system 3
#CREATE NOD:V = LIST(LI = 1,-
  SA = 211)
#CREATE NOD11:B = %NOD

#CREATE APL:V=LIST(-
TT=”EXTERNAL”,-
NA= “APL5”
ND=11,-
TN=1)
#CREATE APL2:B=%APL
```

Configuring Base system 2

```
Link 1 (LAN link):

#CREATE LIN:V = LIST(-
LT=“LAN”,-
#CREATE LIN1:B=%LIN

#CREATE NOD:V=LIST(-
LI=1,-
SA = 209)
#CREATE NOD9 : B = % NOD

#CREATE APL:V=LIST(-
TT=”EXTERNAL”,-
NA= “APL1”
ND=9,-
TN=1)
#CREATE APL2:B=%APL
```

Configuration of Front-end system

```
Link 1 (LAN link):

#CREATE LIN:V = LIST(-
LT=“LAN”,-
#CREATE LIN1:B=%LIN

#CREATE NOD:V=LIST(-
LI=1,-
SA = 209)
#CREATE NOD9 : B = % N O D

#CREATE APL:V=LIST(-
TT=”EXTERNAL”,-
NA= “APL1”
ND=9,-
TN=1)
#CREATE APL1:B=%APL
```

3.7.1. Configuring Local Area networks (LAN)

To connect a base system to a LAN, create a LINn:B object with the following attributes (refer to the ***System Objects manual***):

LT = "LAN"

TR = "TCP/IP"

All workplaces and base systems can use the same LIN object, that is only one LIN object definition is required. No LIN object is required for the LAN, if the base system uses LAN only for communication with workplaces running X software.

LAN nodes

In the LAN network, each connected base system and workplace has a LAN node name or number. The LAN node names are used in the MicroSCADA Pro configuration to achieve communication between base systems, between base systems and LAN connected devices. Use static IP addressing. This indicates that the computer is manually configured to use a specific IP address. Using DHCP for IP assignment is not verified. See Fig. 3.7.1.-1 to get an idea about Base System Configuration:

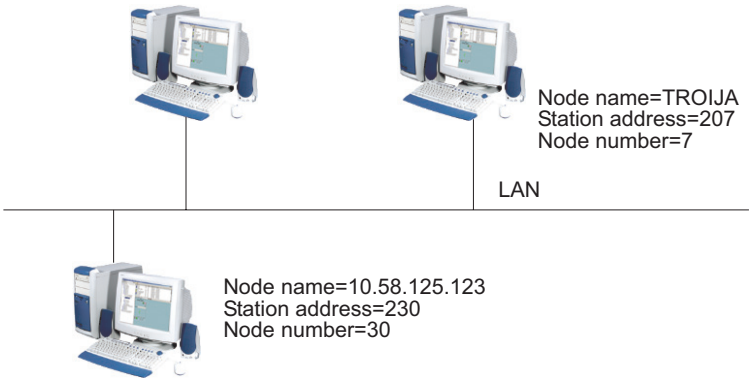


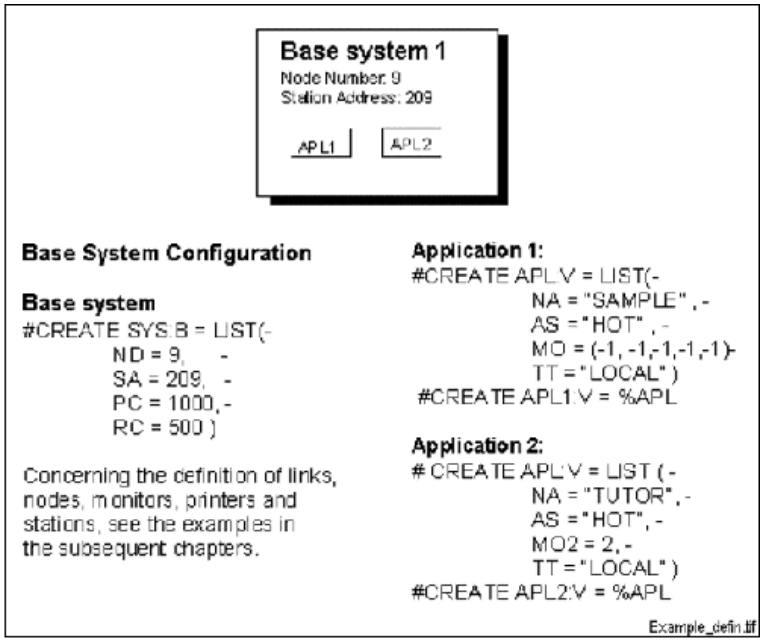
Fig. 3.7.1.-1 Example of a MicroSCADA Pro configuration for a LAN

```
Link to other SYS or LAN frontend (requires TCP/IP)

#CREATE LIN:V = LIST(-LT = "LAN")    ;Link type
#CREATE LIN1:B = %LIN
#CREATE NOD:V = LIST(-         ;Node for LAN frontend or SYS
  LI = 1,-
  NN = "TROIJA",-
  SA = 207)
#CREATE NOD7:B = %NOD

#CREATE NOD:V = LIST(-          ;Node for LAN frontend or SYS
  LI = 1,-
  NN = "10.58.125.123",-
  SA = 230)
#CREATE NOD30:B = %NOD
```

3.7.2. Communicating between applications

Communication between applications means that the object data in one application can be read and written from another one by means of the object notations. Communication between applications in the same base system, that is between two local applications, is achieved simply by application mapping (the APLn:BAP attribute).

Communication between applications in separate base systems requires that the base systems are physically connected to each other, either through direct serial lines, through LAN, as shown in Fig. 3.7.2.-1. The configuration and communication principles are the same, independently of the route between the base systems. The communicating base systems are identified to each other by node numbers and station addresses and the link to the nearest node. The route through the network need not to be defined.



A051610

Fig. 3.7.2.-1 Base system 1 can be configured to access the database of the applications in base systems 2 and 3 as described in Section 6.2. Communication between base system 2 and base system 3 requires that there is an external application in base system 1, which forwards the data between the two base system

3.7.2.1. Local applications

Suppose that application 'a' needs to read and write data in application 'b' in the same base system, as shown in Fig. 3.7.2.1.-1. Application 'b' must then be "introduced to" application 'a' by means of application mapping (refer to the System Objects manual):

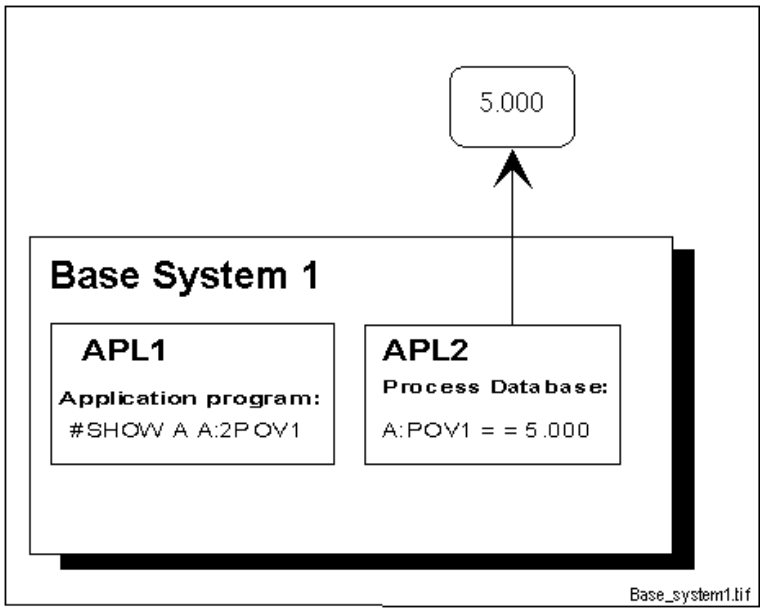
```
#SET APLa:BAPi = b
```

where

'i' The logical application number under which application 'a' recognizes application 'b'

If there are no obstacles, let the logical number be the same as the object number of the application, that is 'i' = 'b'.

For example, setting #SET APL1:BAP2 == 2 means that APL2 is recognized to APL1 by the logical application number 2. In application 1 it is possible to read object data in application 2, for example with the notation: OBJ:2POV1.



A051611

Fig. 3.7.2.1.-1 Illustration of the data communication between applications in the same base system

Base system configuration

See Fig. 3.7.2.1.-1.

Application 1:

```
...
#SET APL:VAP2=2
...
```

3.7.2.2. Applications in separate base systems

Suppose that application 'a' in base system 1 needs to read and write data in application 'b' in base system 2. Then the following configurations are required in base system 1:

1. Create a LINn:B object for the link to the base system 2 (if it does not already exist, refer to Chapter 8 and Chapter 9). If base system 2 is connected via several communication units, the link to the nearest unit is used.
2. Create a NODn:B object representing base system 2, where 'n' is the node number of base system 2. The NODn:B object must be assigned at least the following attributes:

LI	The number of the link to base system 2 (the LINn:B object number, see above)
SA	Station address of base system 2

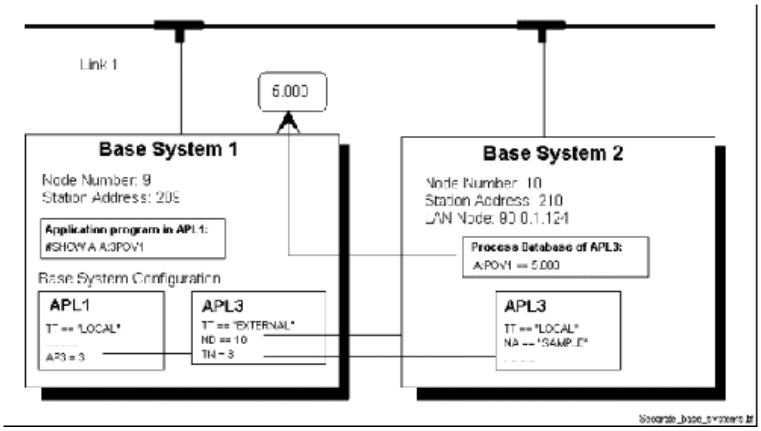
In addition, if LAN is used:

NN	LAN node name of base system 2 (see “LAN nodes” on page 55).

3. Create an external application, an APLn:B object, referring to application 'b' in base system 2. For clarity, use the same object number ('n') as the application object number in base system 2 (although this is not a requirement), that is create APLb:B. Assign the APLb:B object the following attributes:

TT	"EXTERNAL"
ND	Node number of base system 2
TN	Application object number in base system 2 ('b')

4. Map the external application in base system 1 to the communicating application, application ‘a’, by setting APLa:BAPi = b, where 'i' is the logical application number under which application ‘a’ recognizes application ‘b’. If there are no obstacles, let the logical number be the same as the object number of the application (that is 'i' = 'b').



A051612

Fig. 3.7.2.2.-1 Illustration of the configuration and data communication between two applications situated in separate base systems

LAN link configuration

See Fig. 3.7.2.2.-1.

```
;LAN link:
#CREATE LIN1:B=LIST(-
     LT="LAN",-
     TR="TCP/IP")
;Node for Basesystem 2:
#CREATE NOD10:B=LIST(-
     LI=1,-
     SA=210,-
     NN="90.0.1.124")
;Application 1:
#CREATE APL1:B=LIST(-
     AP3=3)
;Application 3:
#CREATE APL3:B=LIST(-
```

```
TT="EXTERNAL",-
ND=10,-
TN=3)
```

3.8. Configuring redundancy

3.8.1. Hot stand-by base systems

Hot stand-by base system means that two base system computers are interconnected via a LAN in a redundant relationship, where one or both base systems are prepared for fast takeover at system break-down in the other base system. An application in one base system operates as the hot application, while an identical application in the other base system is a stand-by application. The stand-by application is maintained by a continuous shadowing (copying) of data from the hot application.

When a fault occurs in the primary base system (the base system containing the hot application), the shadowing application in the stand-by base system is started and takes over all the operational functions. After recovery and restart of the former primary base system, it can either be used as stand-by base system, whereby the former stand-by base system is the primary base system, or the base systems can be returned to their original tasks.

During normal operation, the two base systems can function independently, each running one or more applications, for example electrical energy distribution and district heating. Alternatively, one base system can be reserved exclusively for stand-by duty. Both base systems can contain several applications connected with an application in the other base system in a shadowing relationship. In the following description, it is assumed that the base systems contain only one shadowing application pair, but the same principles apply to systems with several shadowing applications.

3.8.1.1. Configuring hot stand-by systems

Two base systems, based on the same or different hardware, are interconnected via a LAN.

Minimum configuration:

- Two complete base systems connected to a LAN, each including at least two applications; one main application, which is a part in the hot-stand-by relation, and one watchdog application which is dedicated for monitoring the main application and performing a switch over when needed.
- LAN, TCP/IP.
- A standard watchdog application software package in each base system. The watchdog software package contains command procedures and data objects for monitoring the operation and reconfiguring at switchover.

Options:

- Additional applications in both base systems
- Operator workplaces

The most reliable hot-stand-by configuration is obtained with stations of type S.P.I. D.E.R. RTU and SPACOM.

1. Install the MicroSCADA Pro Technology software for both base systems as described in the Installation manual.
2. Edit the SYS_BASCON.HSB template and rename it for both base systems.
3. Start the base system that should have the hot application.
4. Install the watchdog software.
5. Define the external watchdog application and start the main application.
6. Repeat steps 4 and 5 in the other base system.
7. Edit the command procedures in the watchdog applications for both base systems.

3.8.1.2. SYS_BASCON.HSB

The MicroSCADA Pro software delivery includes a version of SYS_BASCON. COM template, SYS_BASCON.HSB, which contains all the necessary configuration definitions for a hot stand-by. The easiest and most reliable method to build the base system configuration for hot stand-by systems is to customize SYS_BASCON.HSB and rename it to SYS_BASCON.COM. Except for the node numbers, the SYS_BASCON.COM files of both base systems can be identical.

```
;File:     Sys_bascon.hsb
;Desription: Standard Base system configuration file
;        for Hot Stand-By systems
;        Version 9.0
;————————————————————

@SYSTEMS = ("SYS_1","SYS_2")    ;SYSTEM NODE NAMES
@THIS_IS = %SYSTEMS(1)        ;IP NODE NAME OF BASE SYSTEM (SYS_1/SYS_2)

@APL_NAME = "TUTOR"          ;NAME OF MAIN APPLICATION
@APL_NUMS = (1,2,3,4)         ;APPLICATION NUMBERS IN THE ORDER:
                    ;(MAIN, WATCH-DOG, ADJ MAIN, ADJ WATCH-DOG)

@NO_OF_VS = 6             ;# OF VS MONITORS
@NO_OF_X  = 0             ;# OF X MONITORS

@LINKS = ("*LAN","RAM1","RAM2","INTEGRATED") ;USED LINKS INDICATED WITH PREFIX "*"

@BS_NODES =    (9,10)       ;BASE SYSTEM NODES
@FE_NODES =    (1,2)        ;FRONT-END NODES
@FE_NODE_LINKS = (1,1)        ;LINK NUMBER OF FE NODES

@NO_OF_STAS = 0            ;# OF STATIONS
@STA_TYP = "RTU"           ;DEFAULT STATION TYPE
@STA_NOD = %FE_NODES(1)       ;DEFAULT NODE FOR STA

@NO_OF_PRIS = 2            ;# OF PRINTERS
@PRI_TYP = "NORMAL"          ;DEFAULT PRINTER TYPE
@PRI_NOD = %FE_NODES(1)       ;DEFAULT NODE FOR PRI


#CASE %THIS_IS
 #WHEN %SYSTEMS(1) #BLOCK
   @MY_NOD     = %BS_NODES(1)
   @ADJACENT_NOD = %BS_NODES(2)
   #BLOCK_END
 #WHEN %SYSTEMS(2) #BLOCK
   @MY_NOD     = %BS_NODES(2)
   @ADJACENT_NOD = %BS_NODES(1)
   #BLOCK_END
#CASE_END

@l_Standard_Paths = do(read_text("/STool/Def/Path_Def.txt"))

#CREATE SYS:B = LIST(-
```

```
  ND = %MY_NOD,-     ;NODE NUMBER
  SA = 200 + %MY_NOD,- ;STATION ADDRESS
  SH = 1,-         ;SHADOWING ENABLED
  DS = %STA_TYP,-    ;DEFAULT STATION TYPE
  DN = %STA_NOD,-    ;DEFAULT STATION NODE
  TM = "SYS",-      ;Time Master, SYS or APL
  TR = "LOCAL",-     ;Time Reference, LOCAL or UTC
  FS = "NEVER",-     ;FILE SYNCH CRITERIA: NEVER,MAINT,SET,CHECKPOINT,ALWAYS
  DE = 0,-         ;DDE server 0=disabled, 1=enabled
  OP = 1,-         ;OPC server 0=disabled, 1=enabled
  PC = 6000,-       ;Picture Cache (kB)
  RC = 1000,-       ;Report Cache (kB)
- ;MS-STOOL Settings
  PH = %l_Standard_Paths,-
  SV = (0,-        ;System Variables
      list(t_System_Configuration_File = "sys_/SysConf.ini",- ;System
Configuration information
         b_Conf_Mech_In_Use  = TRUE,- ;enables/disables start-up configuration
         b_SSS_Mech_In_Use  = TRUE,- ;enables/disables system self supervision
routing
         t_Version = "8.4.3")),-
- ;Operating System events
  OE = 0,-             ;1=Enabled, 0=Disabled
  OT = (Bit_Mask(0,1,2,3,4),-  ;Application events (Bit 0=ERROR, 1=WARNING,
2=INFORMATION, 3=AUDIT_SUCCESS, 4=AUDIT_FAILURE)
     Bit_Mask(0,1,2,3,4),-  ;System events (Bit 0=ERROR, 1=WARNING, 2=INFORMATION,
3=AUDIT_SUCCESS, 4=AUDIT_FAILURE)
      Bit_Mask(0,1,2,3,4)))  ;Security events (Bit 0=ERROR, 1=WARNING,
2=INFORMATION, 3=AUDIT_SUCCESS, 4=AUDIT_FAILURE)

;LIN_BEGIN
 #LOOP_WITH I = 1 .. LENGTH(%LINKS)
  @NAM = SUBSTR(%LINKS(%I),2,0)
  #CASE %NAM
   #WHEN "LAN"     #CREATE LIN1:B = LIST(LT = "LAN")
   #WHEN "RAM1"     #CREATE LIN2:B = LIST(LT = "RAM", SD = "RM00", RE = "BCC")
   #WHEN "RAM2"     #CREATE LIN3:B = LIST(LT = "RAM", SD = "RM01", RE = "BCC")
   #WHEN "INTEGRATED" #CREATE LIN4:B = LIST(LT = "INTEGRATED",-
                              SC = "\SC\PROG\PC_NET\PC_NETS.EXE")
  #CASE_END
 #LOOP_END
;LIN_END

;FE_NOD_BEGIN
 #CREATE NOD:V              ;FRONT-END NODE
 #LOOP_WITH I = 1 .. LENGTH(%FE_NODES)
  #SET NOD:VLI = %FE_NODE_LINKS(%I) ;LINK NUMBER
  @NODE = %FE_NODES(%I)
  #SET NOD:VSA = 200 + %NODE     ;STATION ADDRESS
  #CREATE NOD' NODE' :B = %NOD
 #LOOP_END
;FE_NOD_END

;BS_NOD_BEGIN
 #CREATE NOD:V             ;BASE SYSTEM NODE
 #SET NOD:VLI = 1           ;LINK NUMBER
 #LOOP_WITH I = 1 .. LENGTH(%BS_NODES)
  @NODE = %BS_NODES(%I)
  #SET NOD:VSA = 200 + %NODE     ;STATION ADDRESS
  #SET NOD:VNN = %SYSTEMS(%I)
  #CREATE NOD' NODE' :B = %NOD
 #LOOP_END
;BS_NOD_END

;STA_BEGIN
 #CREATE STA:V = LIST(-
           ND=%STA_NOD,-
           ST=%STA_TYP,-
           TT="EXTERNAL")
 #LOOP_WITH I = 1 .. %NO_OF_STAS
   #SET STA:VTN=%I
   #CREATE STA' I' :B=%STA
 #LOOP_END
;STA_END

;PRI_BEGIN
 @PRI_MAP(1..20) = 0
 #LOOP_WITH I = 1 .. %NO_OF_PRIS
   #CREATE PRI:V
   #SET PRI:VND=%PRI_NOD
   #SET PRI:VDT=%PRI_TYP
   #SET PRI:VTT="LOCAL"
```

```
   #SET PRI:VTN=%I
   #IF PRI:VND == %MY_NOD #THEN #SET PRI:VDC = "LINE"
   #ELSE #SET PRI:VDC="NET"
   @PRI_MAP(%I) = %I
   #CREATE PRI' I' :B=%PRI
 #LOOP_END
;PRI_END

;MON_BEGIN
 @FIRST_FREE_MON = 1
 @MON_MAP(1..50) = 0

 #LOOP_WITH I = 0 .. (%NO_OF_VS - 1)
  @MON = %FIRST_FREE_MON
  @FIRST_FREE_MON = %FIRST_FREE_MON + 1
  @MON_MAP(%MON) = -1
  #CREATE MON'MON' :B = LIST(TT = "LOCAL", DT = "VS")
 #LOOP_END

 #LOOP_WITH I = 0 .. (%NO_OF_X - 1)
  @MON = %FIRST_FREE_MON
  @FIRST_FREE_MON = %FIRST_FREE_MON + 1
  @MON_MAP(%MON) = -1
  #CREATE MON'MON' :B = LIST(TT = "LOCAL", DT = "X")
 #LOOP_END

;MON_END


;Create Application specific global paths
@l_Global_Paths = list()

;Add LIB5xx global paths to list if LIB5xx installed
@t_LIB_Path_Def_File = "/LIB4/Base/Bbone/Use/Bgu_Glpath.txt"
#if File_Manager("EXISTS", Fm_Scil_File(%t_LIB_Path_Def_File)) #then #block
  #error continue
  @v_File_Contents = read_text(%t_LIB_Path_Def_File)
  #if substr(%v_File_Contents(1),5,16) == "LIB 500 revision" and substr(%
v_File_Contents(1),22,5) >= "4.0.2" #then #block
    #modify l_Global_Paths:v = do(read_text(%t_LIB_Path_Def_File))
  #block_end
  #error stop
#block_end

#if substr(SYS:BPR, 1, 7) == "SYS_600" #then #block ; PP

  ;Add SA_LIB global paths to list
  @t_SALIB_Path_Def_File = "/SA_LIB/Base/Bbone/Use/Bgu_Glpath.txt"
  #if File_Manager("EXISTS", Fm_Scil_File(%t_SALIB_Path_Def_File)) #then #block
    #error continue
    @v_File_Contents = read_text(%t_SALIB_Path_Def_File)
    #if substr(%v_File_Contents(1),5,14) == "SA LIB version" and substr(%
v_File_Contents(1),20,5) >= "1.0.0" #then #block
      #modify l_Global_Paths:v = do(read_text(%t_sALIB_Path_Def_File))
    #block_end
    #error stop
  #block_end

#block_end

;WD_APL_BEGIN   *** LOCAL WATCHDOG ***
 #CREATE APL:V
 #SET APL:VNA = "WD"       ;APPLICATION NAME
 #SET APL:VTT = "LOCAL"     ;TRANSLATION TYPE
 #SET APL:VAS = "HOT"      ;APPLICATION STATE
 #SET APL:VPQ = 2         ;PARALLELL QUEUES
 #SET APL:VMO = %MON_MAP     ;MONITOR MAPPING
 #SET APL:VPR = %PRI_MAP     ;MONITOR MAPPING
                  ;APPLICATION MAPPING
 #LOOP_WITH I = 1 .. LENGTH(%APL_NUMS)
  @NUM = %APL_NUMS(%I)
  #SET APL:VAP(%NUM) = %NUM
 #LOOP_END
 @APLN = %APL_NUMS(2)
 #CREATE APL'APLN' :B = %APL
;WD_APL_END

;The usage of OI  OX -attributes
@SV(15) = LIST(-
        Process_Objects=LIST(-
          OI=LIST(-
            Title1=VECTOR("Substation"),-
```

```
          Title2=VECTOR("Bay"),-
          Title3=VECTOR("Device"),-
          Title4=VECTOR(""),-
          Title5=VECTOR(""),-
          Length1=10,-
          Length2=15,-
          Length3=5,-
          Length4=0,-
          Length5=0,-
          Field1=VECTOR("STA"),-
          Field2=VECTOR("BAY"),-
          Field3=VECTOR("DEV"),-
          Field4=VECTOR(""),-
          Field5=VECTOR("")),-
        OX=LIST(-
          Title1=VECTOR("Object text"),-
          Length1=30)))


;MAIN_APL_BEGIN  *** LOCAL HSB APPLICATION ***
 #CREATE APL:V
 #SET APL:VNA = %APL_NAME    ;APPLICATION NAME
 #SET APL:VTT = "LOCAL"     ;TRANSLATION TYPE
 #SET APL:VAS = "COLD"      ;APPLICATION STATE (STARTED BY WD)
 #SET APL:VPQ = 5         ;PARALLELL QUEUES
 #SET APL:VPH = %l_Global_Paths;GLOBAL PATHS
 #SET APL:VSV = %SV        ;SYSTEM VARIABLE (RESERVED)
; #SET APL:VRC = VECTOR("FILE_FUNCTIONS_CREATE_DIRECTORIES"),- ;Revision
compatibility
                  ;SHADOWING MANDATORY ATTRIBUTES
 #SET APL:VSN = %APL_NUMS(3)  ;SHADOW APPLICATION
 #SET APL:VSW = %APL_NUMS(2)  ;SHADOW WATCHDOG
                  ;SHADOWING OPTIONAL ATTRIBUTES
                  ;WITH DEFAULT VALUES
; #SET APL:VSC = 120        ;SHADOW MAXIMUM CONNECTION TIME IN SECONDS
 #SET APL:VSR = 5         ;SHADOW MAXIMUM RECEIVE WAIT TIME IN SECONDS
; #SET APL:VSI = 1000       ;SHADOW DIAGNOSTIC INTERVAL IN MILLISECONDS
 #SET APL:VSY = 60         ;SHADOW TIME SYNC INTERVAL IN SECONDS
 #SET APL:VHP = "DATABASE"   ;History Logging Policy ("DATABASE", "EVENT_LOG",
"NONE")
 #SET APL:VEE = 0         ;System Events  Operating System Events (1=Enabled,
0=Disabled)
                  ;MONITOR MAPPING
 #SET APL:VMO = %MON_MAP
                  ;APPLICATION MAPPING
 #LOOP_WITH I = 1 .. LENGTH(%APL_NUMS)
  @NUM = %APL_NUMS(%I)
  #SET APL:VAP(%NUM) = %NUM
 #LOOP_END
 @APLN = %APL_NUMS(1)
 #CREATE APL'APLN' :B = %APL
;MAIN_APL_END


;ADJ_WD_APL_BEGIN  *** ADJACENT WATHDOG ***
 #CREATE APL:V
 #SET APL:VNA = "ADJ_WD"    ;APPLICATION NAME
 #SET APL:VTT = "EXTERNAL"   ;TRANSLATION TYPE
 #SET APL:VND = %ADJACENT_NOD  ;NODE NUMBER
 #SET APL:VTN = %APL_NUMS(2)  ;TRANSLATED OBJECT NR
 @APLN = %APL_NUMS(4)
 #CREATE APL'APLN' :B = %APL
;ADJ_WD_APL_END

;ADJ_MAIN_APL_BEGIN  *** ADJACENT HSB APPLICATION ***
 #CREATE APL:V
 #SET APL:VNA = SUBSTR("ADJ_" + %APL_NAME,1,10) ;APPLICATION NAME
 #SET APL:VTT = "EXTERNAL"       ;TRANSLATION TYPE
 #SET APL:VND = %ADJACENT_NOD      ;NODE NUMBER
 #SET APL:VTN = %APL_NUMS(1)      ;TRANSLATED OBJECT NR
 @APLN = %APL_NUMS(3)
 #CREATE APL'APLN' :B = %APL
;ADJ_MAIN_APL_END

;_________________________
;Station Types

#SET STY3:BCX  = "ANSI X3-28"
#SET STY4:BCX  = "SPIDER RTUs"
#SET STY5:BCX  = "SINDAC (ADLP80 S)"
#SET STY6:BCX  = "P214"
#SET STY7:BCX  = "SINDAC (ADLP180)"
```

```
#SET STY8:BCX  = "PAC-5"
#SET STY9:BCX  = "SATTCON/COMLI"
#SET STY17:BCX = "LON"
#SET STY20:BCX = "LCU 500"
#SET STY21:BCX = "SPACOM"
#CREATE STY22:B = LIST(NA = "SPI", DB = "STA", CX = "S.P.I.D.E.R/RP570")
#CREATE STY23:B = LIST(NA = "LMK", DB = "REX", CX = "LonMark")
#CREATE STY24:B = LIST(NA = "ADE", DB = "STA", CX = "Ademco")
#CREATE STY25:B = LIST(NA = "PCO", DB = "STA", CX = "Procontic / RCOM")
#CREATE STY26:B = LIST(NA = "WES", DB = "STA", CX = "Westinghouse")
#CREATE STY27:B = LIST(NA = "ATR", DB = "STA", CX = "Alpha Meter")
#CREATE STY28:B = LIST(NA = "PLC", DB = "RTU", CX = "PLC")
#SET STY29:BCX  = "IEC"
#SET STY30:BCX  = "DNP"

;_________________________
;Node, Link for PC-NET Stations

@i_Status = do (read_text("Sys_Tool/Create_C.scl"), "BASE_SYSTEM")
```

To configure the hot stand-by functionality in SYS_BASCON.HSB:

1. Edit the variables in the upper part of the file. See the SYS_BASCON.HSB file above.

SYSTEMS	System node names for both base systems in the hot stand-by.
THIS_IS	The node name of the base system in question. Note that this number is different in the other hot stand-by base system configurations.
APL_NAME	The name of the main application. Give the main applications the same name in both base systems.
APL_NUMS	The numbers of the main and watchdog applications, and the main and watchdog applications in the partner base system.

   Other variables define the used links (marked by an asterisk) and the total number of stations. The default stations defined in SYS_BASCON.HSB are of type S.P.I.D.E.R. RTU ("RTU") and connected to node 1.

2. Define the base system as a SYS:B object with the Shadowing attribute SH = 1.
3. If the system contains other than default types of stations, or stations connected to other nodes, edit the STA block. If there are several types of stations, or stations connected to different nodes, copy the STA block and edit the copied block.

You can also want to check the application definitions. The configurations below are default values that can often be used as such.

The local watchdog application, an APLn:B object with:

- Shadowing State

  SS = "NONE"

- Application State

  AS = "HOT"

The external applications, APLn:B, for the main (partner) and watchdog applications in the redundant base system.

The main application, an APLn:B object. The following shadowing attributes are specified:

Application State	AS	"COLD"
Application Mapping	AP	Both the watchdog application and the external applications are mapped to the application
Monitor Mapping	MO	The monitors (windows) are mapped for the application
Shadowing Number	SN	The logical application number of the shadowing application according to the AP attribute
Shadowing Watchdog	SW	The logical application number of the watchdog application according to the AP attribute
Shadowing Flush Time	SF	The maximum time interval between shadowing data transmission
Shadowing Diagnostic Interval	SI	The time interval between diagnostic commands from the primary system to the hot stand-by
Shadowing Connection Time	SC	Time-out for contact taking with the stand-by application
Shadowing Receive Timeout	SR	Time-out of the hot stand-by connection
Time Synchronization Interval	SY	Time synchronization interval

This base system configuration means that both main applications are COLD when the base systems are started, only the watchdog applications are running.

The principles for the initial configuration of a hot stand-by base systems in SYS_BASCON.HSB are also shown in Fig. 3.8.1.2.-1.

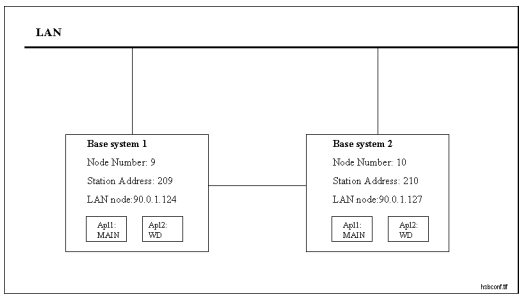


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Fig. 3.8.1.2.-1 Example of two redundant base systems

Table 3.8.1.2.-1 Start-up configurations for two redundant base systems. The example illustrates only the attributes and parameters that are significant for hot stand-by

Configuration of base system 1:	**Configuration of base system 2:**
Base system: SH=1	Base system: SH=1

Table 3.8.1.2.-1 Start-up configurations for two redundant base systems. The example illustrates only the attributes and parameters that are significant for hot stand-by (Continued)

Configuration of base system 1:	Configuration of base system 2:
Application 1 (internal): • NA = “TUTOR" • AS = “COLD” • SN = 3 • SR = 5 • SW = 2 • SY = 0 • AP = (1,2,3,4)	Application 1 (internal): • NA = “TUTOR" • AS = “COLD” • SN = 3 • SR = 5 • SW = 2 • SY = 0 • AP = (1,2,3,4)
Application 2 (internal, default application): • NA = “WD” • AS = “HOT”	Application 2 (internal, default application): • NA = “WD” • AS = “HOT”
Application 3 (external): • NA = “ADJ_MAIN” • TT = “EXTERNAL” • ND = 10 • TN = 1	Application 3 (external): • NA = “ADJ_MAIN” • TT = “EXTERNAL” • ND = 9 • TN = 1
Application 4 (external): • NA = “ADJ_WD” • TT = “EXTERNAL” • ND = 10 • TN = 2	Application 4 (external): • NA = “ADJ_WD” • TT = “EXTERNAL” • ND = 9 • TN = 2

3.8.1.3. Watchdog application

The watchdog application software package handles the following procedures for all hot stand-by applications within a base system:

- When the base system is started, it checks which main application was operating last and sets the state of the application to "HOT_SEND".
- During the operation, it monitors the messages sent from the hot application. If no messages are received in a specified time defined by the Shadowing Receive Timeout (SR) attribute a switchover is started and the stand-by application is set to "HOT" and "HOT_SEND".
- If the hot system does not get acknowledgments from the stand-by system, it regards the connection as broken, and the shadowing stops (SS = "NONE"). The watchdog application then checks the connection by sending commands cyclically (with a few minutes interval) to the stand-by system, and starts shadowing (SS = "HOT_SEND") when the connection is re-established.

Installing Watchdog application

To install the watchdog application package:

1. Enter the **Base System Tool** from the Tool Manager.
2. Select **Base Objects**.
3. Select **Tools > HSB Management**.

   A window is displayed with the following information:

   Installed Package: The name and revision date of a previously installed package.

Status: The status of the installed package, running or not running.

Disk Package: The hot stand-by software package installed on a disk

STATUS: The status of the disk package (OK, incomplete, and so on).

4. Click **Install** to install the watchdog software package.
5. Wait until the watchdog software is installed. The installation creates for example command procedures (names beginning with SHAD, data objects and time channels). When the installation is complete, the name and revision date of the package appears in the INSTALLED PACKAGE field.

Editing the command procedures of Watchdog application

The watchdog application package contains command procedures, which are described below. The following command procedures can be freely customized, whereas the others should not be edited. Note that while editing the command procedures the first part of the files should be left as they are and the modifications are added to the end of the file.

SHADUSR	The generation of alarms and events in the situations when: • Hot stand-by transmission starts • File and RAM dump is ready • Connection is lost to the receiver (in the stand-by system) • Takeover starts • Change of state occurs in the partner application.
SHADMAPMON	The shifting of monitors at takeover, for example mapping monitors for the main application, or opening application windows using the SCIL function OPS_CALL and the mons.exe command. See the example in the System Management manual. When a monitor is mapped to an application, an event channel MON_EVENT is activated. This can also be used in registering the SD attribute of an X terminal, for example in the Instruction (IN) attribute of a command procedure. At switchover, the SD attribute can be used for opening a window in the same terminal.

SHADMAPNET	Reconfiguration of the communication units at takeover. Do the following NET reconfiguration at takeover: • Redefinition of the APL object in NET corresponding to the main application. • Retransmission of the last RP 570 and SPA transactions by writing to the NETn: SLT attribute of the NET. Up to 30 transactions are stored in NET. • Reconfiguration can also be done in a command procedure started by the event channel APL_INIT_H, which is executed when the stand-by application is set to HOT instead of APL_INIT_1 and 2.
SHADGOHOT	Specifies whether the main application is allowed to be set HOT when a lost connection has been discovered. The command procedure can contain a check of the error, for example if the communication disturbance is due to a communication fault on the LAN connection to the stand-by system. Then no switchover should be performed. Default: the application is set to HOT.
SHADREMHOT	Specifies whether the main application is allowed to remain HOT when also the stand-by application is HOT. Such situation can occur at a LAN break. Default: the application remains HOT.
SHADGLOBAL	Defines some global shadowing variables, for example time constants, the keeping of a log file on disk and log file name.

3.8.1.4. Shadowing

To define the external watchdog application and enable hot stand-by:

1. Click Shadowing Applications. The watchdog applications are shown in the middle of the dialog that appears on the screen.
2. Click the field below the text External Watchdog Application, next to the watchdog application whose pair you are about to define.
3. Type the application number of the external watchdog application.
4. Repeat steps 2-4 if you have several watchdog applications.
5. Change the HSB field from OFF to ON for a watchdog application to enable starting of the main application.
6. Wait while the main application becomes hot.

After the HSB has been enabled for both of the watchdog applications, the file dump and shadowing starts.

The takeover should not be done before the file dump is completed.

The file dump is completed when the File dump time is displayed in the Shadowing dialog in Applications dialog in the Base System Configuration Tool.

3.8.2. Hot stand-by with OPC client and servers

This chapter describes the principles of the HSB concept in systems including OPC clients and servers connected to IEC 61850 process devices.

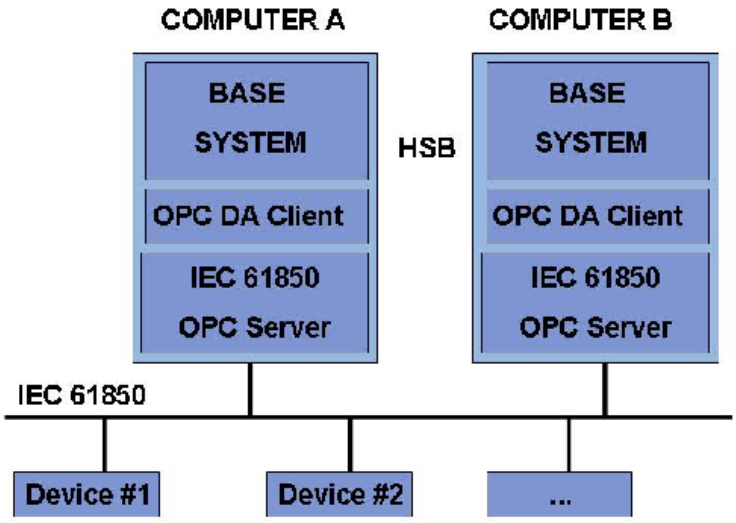

Fig. 3.8.2.-1 Typical HSB system with IEC 61850 process communication

Both computers, A and B, consist of their own MicroSCADA Pro base system, OPC Data Access Client and IEC 61850 OPC Server.

When a fault occurs in the primary base system (computer A) including the HOT application, the shadowing application in the stand-by base system (computer B) is started and it takes over all the operational functions.

Typically there is a need to minimize the switchover time in the hot stand-by systems.

The watchdog application in the stand-by base system monitors the diagnostic commands and messages from the hot application. If no message or diagnostic command is received within a specified time, the watchdog application examines the situation and performs a switchover if needed.

When the stand-by application is set to HOT, a predefined event channel APL_INIT_H is started to be used for re-configuration purposes. See more information in the Chapter for hot stand-by base systems.

3.8.2.1. Configuring IEC 61850 OPC Server

In a hot stand-by system, the IEC 61850 OPC Servers should be active both in a primary (including hot application) and a stand-by (including shadowing application) computer. This enables that data coming from IEC 61850 process devices is stored into buffers of the both IEC 61850 OPC Servers all the time.

3.8.2.2. Configuring IEC 61850 OPC Client

In the SYS_BASCON.COM you need a node definition for a IEC 61850 OPC Client

```
; IEC61850 OPC_Client_Nod_begin
#CREATE NOD:V          ;Client  node
#SET NOD:VLI =  1       ;Client Link number
@NODE =  8           ;Node number
#SET NOD:VSA = 208      ;Node address
#SET NOD:VNN = "HSB1"     ;Name of the base system
#SET NOD:VDI = 10       ;Diagnostic interval
#SET NOD:VDT = 30       ;Diagnostic timeout
#CREATE NOD'NODE':B = %NOD  ;Creating node; IEC61850 OPC_CLIENT_Nod_end
```

For the creation of stations include this in the SYS_BASCON.COM file

```
#CREATE STA:V = LIST(-
  TT = "EXTERNAL",-
  ST = "SPA",-
  TR = "UTC",-
  ND = 8,-
  TN = 60)
#CREATE STA60:B = %STA
```

3.8.2.3. Configuring External OPC Data Access Client

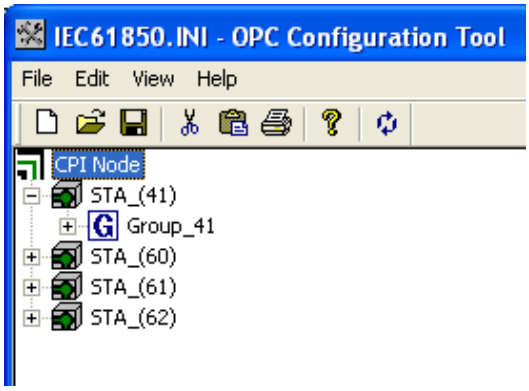

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Fig. 3.8.2.3.-1 Setting of the client communication parameters

In this configuration set the stations in use. Use ‘Enable Circular Buffering' in the OPC Configuration Tool.

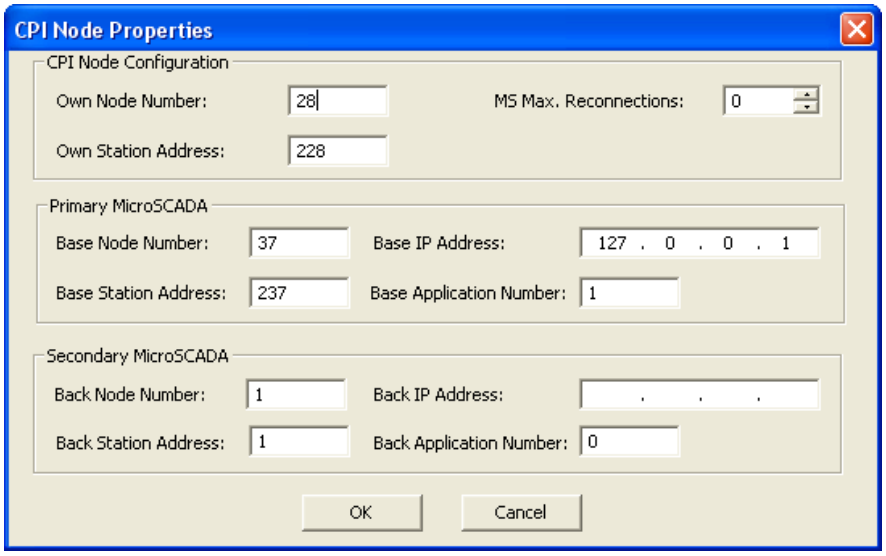

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Fig. 3.8.2.3.-2 Example of the CPI node parameters settings

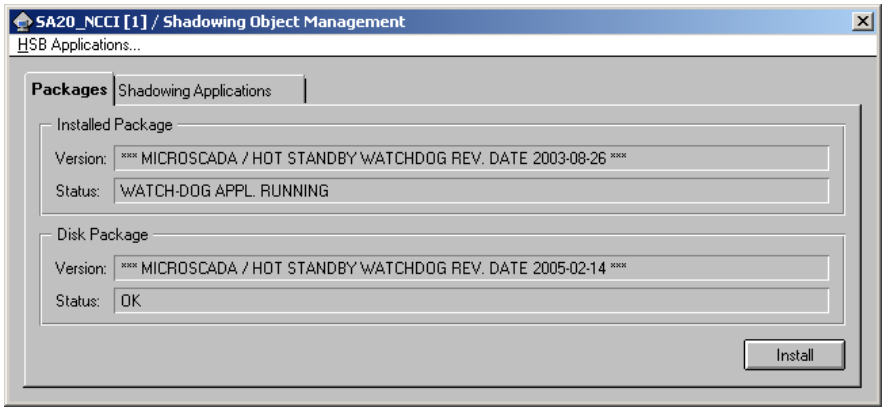

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Fig. 3.8.2.3.-3 Hot stand-by install packages

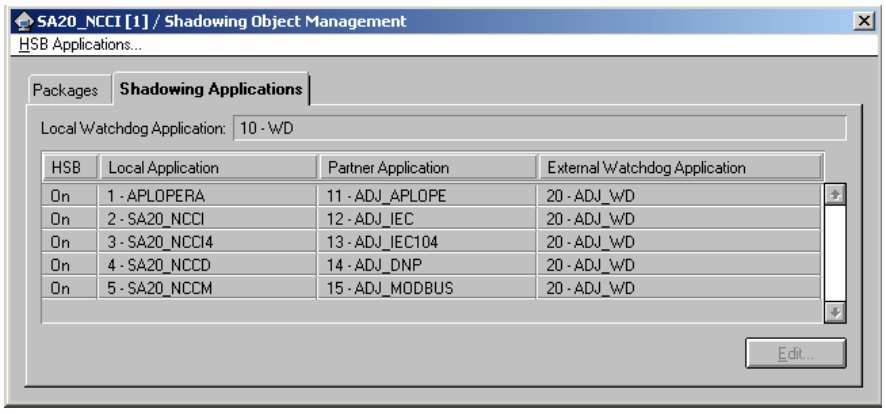

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Fig. 3.8.2.3.-4 Hot stand-by install applications

Starting the IEC 61850 OPC Client can be done in the WD application or in a separate application to start both PC-NETs and the IEC 61850 OPC Clients.

```
APL_INIT_1:C

;This is executed when application gets hot
#exec_after 10 start_opc_da_client_instance:c ;Start Client after a delay

START_OPC_DA_CLIENT_INSTANCE:C
#error ignore
@abb = ops_call("C:\sc\prog\OPC_Client\DA_Client\daopccl.exe -id ""iec61850"" -
start ""C:\sc\sys\active\sys_\iec61850.ini"" -trace normal",0) ;alternative -
trace high
```

Stopping the Client

```
Add line starting with '#exec' below to the Shutdown.cin in the sc\prog\exec
directory:
;Insert site specific code here
#exec STOP_OPC_DA_CLIENT_INSTANCE:11C ;Stop OPC DA Client instances
;Shut down applications
;Search watch dog applications (normally there is one wd in a system)

Create a STOP_OPC_DA_CLIENT_INSTANCE:C

#error ignore
@abb= ops_call("C:\sc\prog\OPC_Client\DA_Client\daopccl.exe -id ""iec61850"" -
stop",0)
```

OPC Data Access Client should be located in the same computer where a base system is running. When application changes to HOT state, the OPC Data Access Client should become configured using the application initialization procedures (APL_INIT_*) as defined in OPC Data Access Client manual.

OPC Data Access Client is located in the same computer as the base system, so there is a need to configure only the Primary MicroSCADA Pro information in the CPI Node Properties of OPC Data Access Client.

In a situations where OPC Data Access Client looses a connection to a MicroSCADA Pro base system, there is a need to configure the event buffering policy. The policy how the OPC Data Access Client buffers events can be specified to be one of the following:

Disable Buffering

When the policy is Disable Buffering, the OPC Data Access Client does not buffer the events.

Enable Normal Buffering

When the policy is Enable Normal Buffering, the OPC Data Access Client buffers the events in a way that the latest update is always stored into the buffer. This occurs independently of the process object type. This is also the default setting.

Enable Circular Buffering

When the policy is Enable Circular Buffering, the OPC Data Access Client buffers events in a way that changes switching device indications so that they are always stored into the buffer as own entries, that is all the state transitions are stored. Regarding measurement updates, the latest update is always stored into the buffer. In case of hot stand-by systems this policy results in a situation, where the same events can appear more than twice after a communication break. However, all the changes of the switching device indications are stored during the communication break, as long as the size of the buffer has not been exceeded.

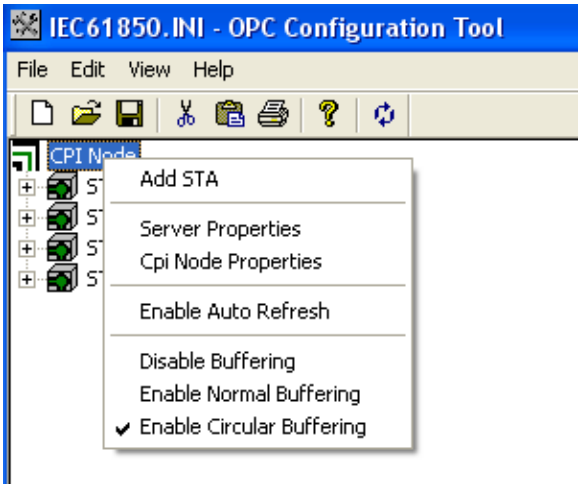

Fig. 3.8.2.3.-5 OPC Configuration Tool - Enable Circular Buffering

3.8.2.4. Configuring IEC 61850 process devices

IEC 61850 process devices should be configured to sent information simultaneously to both servers (double master system).

3.8.3. Configuring redundant IEC 60870-5-104 slaves

The IEC60870-5-104 slave protocol provides a possibility for redundancy which follows the corresponding IEC60870-5-104 standard. Redundancy is used to improve system reliability. Each created IEC60870-5-104 slave line PC_NET process communication unit can be configured to accept up to 12 simultaneous logical connections between the slave line and the master(s). These logical connections can use one or multiple local IP-addresses which may be visible in the same or different LANs. The basic principle in the redundant configuration is that only one of the configured logical connections is active at any time. “Active connection” in this context means that it is used for data transmission. Following figure is an example of a redundant connection in its simplest form:

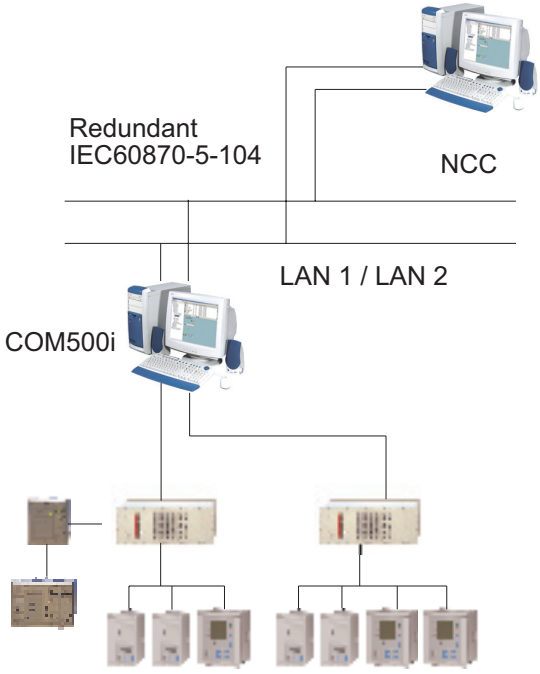

Fig. 3.8.3.-1 Redundant IEC60870-5-104 slave

Although the inactive connections are connected at the TCP level, no data transmission occurs through these connections. The switch of the active connection is always initiated by the master, in the slave end the switch to another connection is done automatically and no application programming is needed.

The configured logical connections may be used also by multiple masters but in this configuration the masters must have co-operation to keep only one connection active at any time. If the set of cross-referenced data points is not equal between the masters or multiple masters are active at the same time, the recommended configuration is to use separate IEC 60870-5-104 slave lines using separate local IP-addresses.

The local IP-addresses used by the created IEC 60870-5-104 slave line are defined with line attribute LD. The IP-addresses of the remote end for each logical connection is configured using the station object attribute IA (indexed form). Station object attributes CS and AC provide information of the states of the connection at run-time.

For more details, refer to the ***IEC 60870-5-104 slave configuration manual***.

3.8.4. Configuring redundant RP 570 slaves

Redundancy in RP570 slave protocol is quite similar to IEC60870-5-101 i.e. one station object is connected to two RP570 slave lines controlling two serial ports. The station type with RP570 slave is SPI. One of the lines is the main line and the data transfer is takes place using this line. The back-up line is passive and is not used for data transfer but a RSEQ – EXR message sequence is used to ensure that the

communication route is in good condition. The communication is switched from the main line to the back-up line and vice versa if the active line is detected to be broken. The line switch is always initiated by the master.

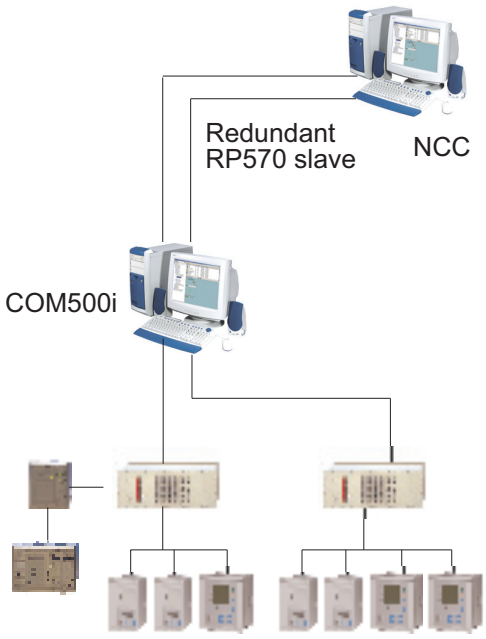

Fig. 3.8.4.-1 Redundant RP570 slave

System configuration tool supports the configuration of the redundant RP570 slave. By creating a RP570 slave line and pressing the “Add redundancy” menu item, the back-up line is created and the same SPI station object can be connected to two lines.

If the system configuration tool is not used, the following steps should be taken to configure a redundant RP570 slave line.

1. Define the main line.
2. Define the back-up line.
3. Define the station.

In order to operate as a redundant pair of lines, the main line and the back-up line must be explicitly configured using the line attributes LI and RU. For more details, refer to the Chapter Redundant line attributes in the System Objects manual, SPI station description.

3.8.5. Configuring redundant IEC 60870-5-101 slaves

The IEC 60870-5-101 slave protocol in PC_NET also provides a possibility for redundancy which follows the corresponding IEC 60870-5-101 standard. In practice, this means that one IEC slave station object is connected to two IEC 60870-5-101 slave lines controlling two serial ports. One of these is treated as the main line and the data transfer takes place using this line. The other line is the back-up line which is activated if the main line fails. If a communication disturbance is

detected, the communication can be switched from the main line to the back-up line and vice versa without losing any messages to be sent to the master. A line switch is always initiated by the master.

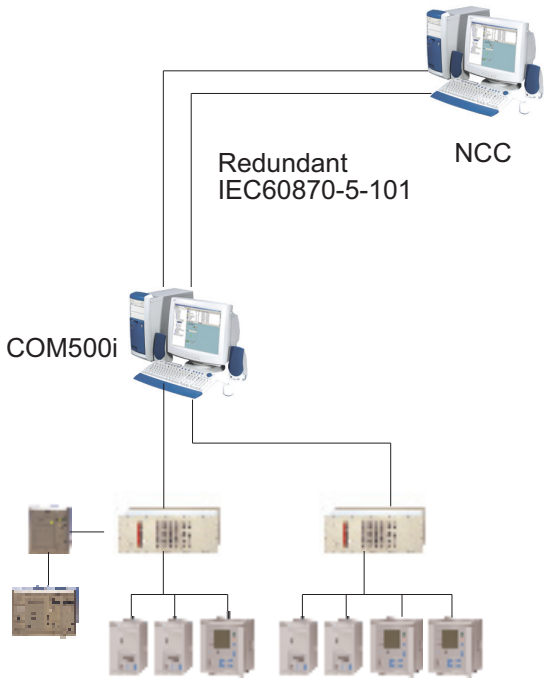

Fig. 3.8.5.-1 Redundant IEC60870-5-101 slave

System configuration tool supports the configuration of the redundant IEC 60870-5-101 slave. By creating a IEC 60870-5-101 slave line and clicking the “Add redundancy” menu item, the back-up line is created and the same IEC station object can be connected to two lines.

If the system configuration tool is not used, the following steps should be taken to configure a redundant IEC 60870-5-101 slave.

1. Define the main line.
2. Define the back-up line.
3. Define the station.

In order to operate as a redundant pair of lines, the main line and the back-up line must be explicitly configured using the line attributes LI and RU. For more details, refer to Chapter Redundant line attributes in the ***IEC 60870-5-101 slave configuration manual***.

3.8.6. Redundant gateways

A single system is a gateway system that contains only one unit of each system component, while a redundant gateway can contain two base systems and/or two serial connections and/or many LAN connections dedicated for the same purpose.

Figure 3.9.3.-1 is a typical HSB system with gateway functionality. Both computers consist of their own SYS 600 base system and COM 500i gateway functionality. When a fault occurs in the primary base system including the HOT application, the shadowing application in the stand-by base system is started and it takes over all the operational functions. For more information, refer to Section 3.8.1. Hot stand-by base systems.

Limitations

- No keep-alive connection to stand-by COM 500i
- Switch is initiated by the hot stand-by application of COM 500i and not by the NCCs
- Events can be lost or doubled when the COM 500i switch occurs

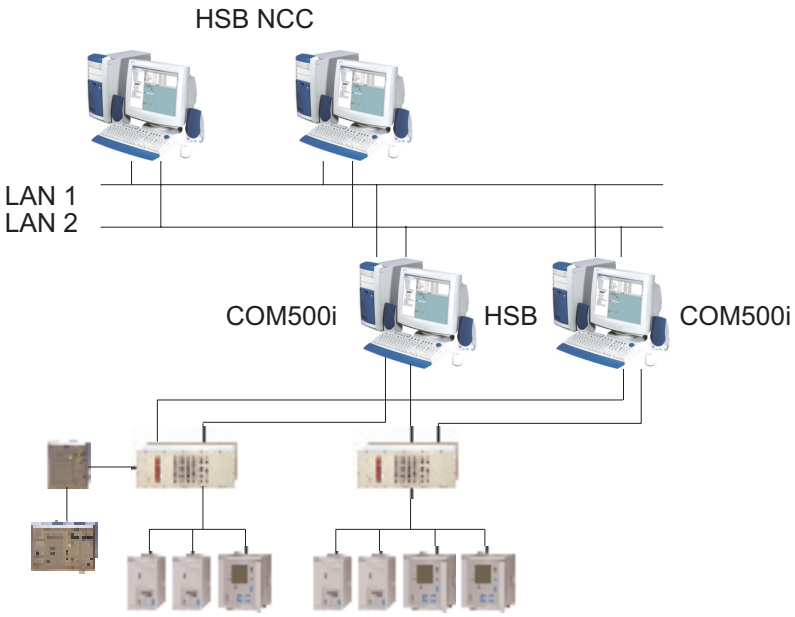

Fig. 3.8.6.-1 Typical HSB system with COM 500i gateway

3.9. Configuring mirroring

Process database mirroring is defined on station (STA:B) object level: a station in SYS 600 that is connected to a PC-NET or some other data source, the host station, is connected to one or more image stations located in other applications, usually in other MicroSCADA Pro machines.

One host station can have up to 10 image stations. In a hierarchical mirroring system, each image station can in turn act as a host to upper-level image stations. The role of a station object and its mapping to a station located in the external application are defined by a couple of station object attributes.

The application containing the host station is called host application (of the station) and the application containing the image station is called the image application (of the station). Note however that an application can have both host and image stations, so it can act in different roles for different stations.

The process objects of a host station and an image station are mapped according to their object address (OA and OB) or source name (IN or IN/EH of OPC based objects). If the object address or the source name of a process object is identical in the host and image database, the objects are considered to denote the same signal in the station device. The logical names of the process objects can be different in different databases.

All the process objects in an image database that are in use (IU = 1) have the switch state AUTO (SS = 2) and map to an in-use AUTO state process object in a host database, are subject for mirroring. No new process object attributes are used to configure mirroring communication.

An image application subscribes to the events of process objects in its process database. The image database can only contain a subset of addresses found in the host database, the uninteresting signals can be dropped from the communication load.

The mirroring function contains the following sub-functions:

1. The host application replicates the messages from the station device to each image application that has subscribed to the object address.
2. The process commands (#SET and #GET) executed in an image application are routed to be executed by the host application. The changed OV value is sent to the image applications by the host.
3. Any access of STA:S attributes in an image application is routed to be executed by the host application.
4. The host application replicates the system messages from the NET to each image application that has subscribed to the system messages.

The mirroring communication between the host and image application is implemented as APL-APL communication. Consequently, LAN, WAN and serial communication can be used. The APL-APL communication between the host and image applications must be configured to enable mirroring.

The communication between the host and the image is buffered and the communication breaks are handled automatically. The events that have occurred during the break are sent when the connection is re-established.

The hot-stand-by configurations are supported and the switch-overs are handled automatically without losing any events.

Mirroring can be disabled or enabled on a host/image application pair basis by means of APL object attributes. When mirroring is disabled, the host buffers events, just as during other types of communication breaks.

Significant mirroring events, such as established or lost connections and configuration mismatches, are reported to the application via application events (event channels APL_EVENT and HOST_ADDRESS_MISSING).

Diagnostic counters, implemented as APL object attributes, help monitoring the traffic between the host and image application.

Because it is possible to create very large image applications by using the mirroring function, the maximum number of STA base system objects (MAX_STATION_NUMBER in SCIL) is 5000.

3.9.1. Station mapping

There are three station (STA:B) attributes that define the role and addressing of the station in the mirroring network. The MR (Mirroring Role) attribute defines the role of the station:

- MR = "HOST": This is a host station that transmits the process data to one or more image stations defined by the attribute IS
- MR = "IMAGE": This is an image station that receives the process data from the host station defined by the attribute HS
- MR = "BOTH": This is an image station that receives the process data from the host station defined by the attribute HS. Furthermore, it acts as a host station to the image stations defined by the attribute IS
- MR = "NONE": This station does not participate in mirroring (default)

The HS (host station) attribute of an image station object defines where the corresponding host station is to be found. It has a list value with the following attributes:

APL	The number of the (usually external) host application
UN	The unit number of the host station in the host application

The IS (Image Stations) attribute of a host station object defines where the corresponding image stations are found. The attribute is a vector of up to 10 list values with the following attributes:

APL	The number of the (usually external) image application
UN	The unit number of the image station in the image application

3.9.2. Process messages

In principle, all the messages from the station device to the host database are replicated by the host database and sent to the image applications that have subscribed to the object address. For the load control, however, some measurement events can have been dropped, see 3.9.7. Buffering and communication breaks for details. In a hierarchical mirroring network, the image application can also act as a host and re-replicate the messages and send them further to their upper-level image applications.

The substituted values of the process objects (the ones written by SCIL along with the SU attribute) are handled as real process values, that is they are subject to the mirroring as well. This feature can be used to send mirroring events by SCIL. Define an AUTO state process object with a pseudo-address (an address having no real counterpart in the process station) and write to it by using the following notation:

```
#SET ABC:P1 = LIST(OV = 1, SU = 1)
```

3.9.3. Process commands

Process commands, that is #GET commands and #SET commands of the OV (BO, DO, AO or BS) attribute of an AUTO state process object, are sent to the host application which executes them on behalf of the image application. In a hierarchical mirroring network, the commands are delivered to the lowest level host. If the command is successful, the new OV value is distributed as a mirroring event to the host database and all the image databases. If it is unsuccessful, the status of the failed command is returned to the controlling SCIL program in the image application.

When a process command is executed by the host application, the new OV value is mirrored to all image databases.

3.9.4. System object (STA:S) communication

Evaluation of STA:S object attributes in an image application, as well as the SET command (#SET) and GET command (#GET), is routed via the mirroring mechanism to the lowest level host application, which executes the request on behalf of the image application. The results (the status of SET and GET command and the result of evaluation) are back-routed to the image application. The host database and other image applications are affected only if the setting/getting/ evaluation indirectly generates messages from the station.

Because of the routing via the mirroring mechanism, the tools that communicate with a station via its system object attributes may be run in an image application without any SCIL code changes.

3.9.5. System messages

System messages from the NET are delivered to image applications in a similar way as process messages. The difference in configuration is that in the host application the system messages are always sent to virtual unit number 0.

In the image application, a non-zero unit number must be reserved for each host whose system messages are received. This unit then represents the virtual unit 0 of the host. As in process messages, the process objects within this unit and the host unit 0 are mapped by their object addresses. In the STA object of the image database, the unit is mapped to unit 0 of the host application by setting HS = LIST

(APL = host_application, UN = 0). When the image application starts up, it subscribes to the system messages (object addresses) of the unit in the same way as it subscribes to the process messages.

In the host application, no STA objects related to system message mirroring are needed because system messages are always received to unit 0. Instead, the image stations which receive system messages are listed in a new application attribute IS (Image Stations for System Messages).

The IS attribute of the host application is similar to the IS attribute of a host station. It is a vector of up to 10 list values, which define the image stations mapped to the system messages of this host application.

3.9.6. Subscriptions

The communication between the host and image is subscription-based. When the image application successfully connects to the host, it scans through its process database and sends a list of object addresses that it is interested in, that is the addresses that:

- Are in use
- Are in AUTO switch state
- Belong to a unit (station) that is connected to the host.

When the host receives a subscription, it immediately sends back the current value of the object (with CT, cause of transmission, set to INTERROGATED). If the requested object address is not found in the host database, an ADDRESS_MISSING event is sent back.

An address is unsubscribed when a mirrored process object in the image database is:

- Deleted
- Turned out of use
- Set out of switch state AUTO

On the other hand, when an in-use AUTO object is created, the image application automatically subscribes to its events.

When an object with subscriptions to it is deleted or its state switched from in-use AUTO state in the host database, an ADDRESS_MISSING event is sent to all the subscribers. When a new process object is created (or switched to in-use AUTO state), a NEW_ADDRESS event is sent to the image applications. They can then decide to subscribe to its events.

The database of the image application can only be a subset of the host database, thereby reducing the required communication rate.

Each image application does its own subscription. The subscriptions can be different.

3.9.7. Buffering and communication breaks

The events to be sent to image applications are buffered by the host system. Each external application that serves as an image application in mirroring has its own event queue.

- The EM attribute (Event Queue Length Maximum) of the application defines the maximum length of the queue.
- The EU attribute (Event Queue Used) shows the current length of the queue.
- The EP attribute of the APL object (Event Queue Overflow Policy) specifies the policy to be followed when the maximum length is reached.

Two different event queue overflow policies are defined below:

- EP = "DISCARD": The queue is destroyed, an overflow message is sent to the image and the communication is stalled. In this case, the image application does a general interrogation to the host database, but some events can be lost.
- EP = "KEEP": The events are not allowed to be lost. In this case, the process communication between the host application and PC-NET is slowed down just as if the EU attribute of the host application would have reached EM.

The KEEP policy is obeyed only during the established communication between the host and image. If the limit is reached during a communication break, the DISCARD policy is used.

When the connection to the image application is lost, the host only buffers events without trying to send them. When the image application (or its HSB partner, if there has been a take-over at image site) succeeds in re-establishing the connection, it sends the sequence number of the last received message to the host and requests retransmitting of newer events. If the host still has the requested events in its buffer, it sends them and no events are lost.

If the requested events are no longer available because queue length reached its maximum during the break or because the host has been down, the image application does a new subscription and events can be lost.

During a communication break, the process objects in the image database are marked as old by setting the object status value to 2.

The load control in the communication is done by reducing the rate of measurement events. Measurement event means a process message to an analog input process object when all the following three conditions are met:

1. The object has a real value representation. Integer valued AI objects, that is the ones with IR = 1, are not considered as measurements.
2. The event is a measurement event according to the load control policy of the station, see below.
3. The object address is not included in the list of analog event addresses (attribute AE) of the station, see below.

The LP (Load Control Policy) attribute of the station (STA:B) object defines which analog events can be considered as measurement events according to the description above. The attribute can take one of the following four values:

"KEEP_ALL_ANALOGS"	No analog messages are taken as measurements.
"KEEP_TIME_STAMPED_ANALOGS"	The messages that are not time-stamped by the station are taken as measurements.
"KEEP_NO_ANALOGS"	The analog messages are taken as measurements whether they are time-stamped or not.
"DEFAULT"	The LP attribute of the corresponding STY object is applied.

The station type (STY) objects have a similar LP attribute as well. STY:BLP defines the default policy for all the stations of the type.

For the station types which have the DB attribute value "STA", the "DEFAULT" policy is equivalent to "KEEP_TIME_STAMPED_ANALOGS". Otherwise the default policy is "KEEP_NO_ANALOGS". For more information about the LP attribute of station and station type objects, refer to the System Objects manual.

The AE (Analog Events) attribute of the station (STA:B) object is defined in the host system. Its value is an integer or text vector of any length and it contains a list of the analog input object addresses (OA) or OPC item names (IN) within the station that are not to be taken as measurements in the sense described above.

3.9.8. Hot stand-by

HSB switch-overs are automatically taken care of, no SCIL command procedures are involved.

To be able to do this, the base system must know which external applications make up an HSB pair. Therefore, the SN (Shadowing Number) attribute of the external applications that participate in mirroring must be set. Either of the two applications numbers can be defined as the APL attribute of the HS or IS attribute of the stations participating in the mirroring.

For example, if in an image system the external host applications 7 and 8 make up an HSB pair, the SN attribute of APL7 must be set to 8 and the SN attribute of APL8 must be set to 7. Either 7 or 8 can be defined as the APL attribute of the HS attribute of the stations located in the host.

No events are lost due to HSB switch-overs because the mirroring event queues are shadowed by the host application and the events are sequence-numbered. After an HSB switch-over of the host or the image application, the image application asks the host to retransmit all the events that are newer than the last received event.

3.9.9. Disabling mirroring

In an image system, the mirroring communication with a particular host application can be temporarily disabled by setting the HE (Host Enabled) attribute of the host's APL object to 0. Mirroring is re-enabled by setting the attribute back to 1.

In a host system, the mirroring communication with a particular image application can be temporarily disabled by setting the IE (Image Enabled) attribute of the image's APL object to 0. Mirroring is re-enabled by setting the attribute back to 1.

While the mirroring is disabled, the host buffers events breaks, just like during other types of communication, and sends them to the image when the mirroring is enabled again

3.9.10. Application events

Various significant mirroring events are reported to the application via application event channels APL_EVENT and HOST_ADDRESS_MISSING. For full description of these event channels, refer to the Application Objects manual, Predefined application event channels.

HOST_ADDRESS_MISSING is used in an image application to log the object addresses that according to the image database should be mirrored but are not found in the host database.

APL_EVENT is used both in the host and in the image application.

The events reported by the event channel in the image application are the following:

Source	Event	Description
“UN”	“MISSING”	The connection to the host station cannot be established because of a mismatch in STA object configuration between the image and the host.
	“LOST”	The connection to the host station is lost because the mirroring configuration (either MR or IS) in the host has been changed.
	“FOUND”	The connection to the host station is established because the mirroring configuration in the host has been changed.
	"HOST_LOST"	A "LOST" event for the unit has occurred in the intermediate level host. This event is generated instead of the "LOST" unit to tell the application that there is nothing wrong with the mirroring configuration between this application and the intermediate level application, but the configuration mismatch is detected on a lower level.
	"HOST_FOUND"	The configuration problem lower in the mirroring hierarchy has been fixed.
“HOST”	“CONNECTED”	The connection to the host is established.
	“LOST”	The connection to the host is lost.

Table 3.8.6.-1 Start-up configurations for two redundant base systems. The example illustrates only the attributes and parameters that are significant for hot stand-by (Continued)

Source	Event	Description
	“DISCONNECTED”	The connection to the host has been lost because there are no stations connected to the host anymore.
	“RECONNECTED”	The connection to the host is re-established without losing any events.
	“OVERFLOW”	The event buffer of the host has overflown. Events have been lost.
	“DOWN”	The connection to the host has been disconnected by the host, because the host application is shutting down.
	“DISABLED”	The communication with the host has been disabled by setting APL:BHE to 0.
	“ENABLED”	The communication with the host has been enabled by setting APL:BHE to 1.
	“HOST_DISABLED”	The communication with the host has been disabled by the host (by setting APL:BIE to 0).
	“HOST_ENABLED”	The communication with the host has been enabled by the host (by setting APL:BIE to 1).

The events reported by the event channel in the host application are the following:

Source	Event	Description
“IMAGE”	“CONNECTED”	The connection to the image is established.
	“LOST”	The connection to the image is lost.
	“DISCONNECTED”	The image application has disconnected the mirroring session.
	“RECONNECTED”	The connection to the image is re-established without losing any events.
	“OVERFLOW”	The event buffer for the image has overflown. Events have been lost.
	“BLOCKING”	The event buffer for the image is full, but because of the defined event queue overflow policy "KEEP", the buffer is not discarded. The connection is now blocking (or slowing down) the communication between the SYS and the NET in order not to lose any events in the image application.
	“NON_BLOCKING”	The event buffer for the image is not full anymore. The connection does not slow down the communication between the SYS and the NET anymore. This event is generated when the length of the event queue (EU) has dropped below 90 % of its maximum (EM).
	“DISABLED”	The communication with the image has been disabled by setting APL:BIE to 0.
	“ENABLED”	The communication with the image has been enabled by setting APL:BIE to 1.

Table 3.8.6.-1 Start-up configurations for two redundant base systems. The example illustrates only the attributes and parameters that are significant for hot stand-by (Continued)

Source	Event	Description
	“IMAGE_DISABLED”	The communication with the image has been disabled by the image (by setting APL: BHE to 0).
	“IMAGE_ENABLED”	The communication with the image has been enabled by the image (by setting APL: BHE to 1).

3.9.11. Configuration examples

The main steps of the mirroring configuration procedure are the following:

1. Create a node for each base system in the mirroring system (and a LAN link).
2. Create an external application for each image in the host system and an external application for each host in the image system.
3. Define the mirroring attributes for each station; the mirroring role (MR) of a station, the image stations (IS) which are to receive events from the host for the host stations and the host station (HS) for image stations.
4. Raise the amount of APL-APL servers (APL:BAA) of each mirroring application to 10. In most real applications, a lower value would do as well, but the cost of 10 servers is low compared to finding out the smallest usable value. If, however, a lower value is preferred, the following rule can be used. In a host application set the APL:BAA attribute to 10 or two times the number of connected image applications, whichever is lower. In an image application, set the AA attribute to 10 or two times the number of connected host applications, whichever is lower.
5. Copy/create the process objects of the image application.

The process database of the image system can be a subset of the host process database. All process objects, which are of interest, can be copied from the host to the image.

Three example configurations are described in the following. The first example describes a simple system where process events are mirrored from a host to an image. Second case is an example of a system where a redundant image system receives process events from several hosts. The usage of station mapping is demonstrated in case 3.

3.9.11.1. Example 1: One host, one image

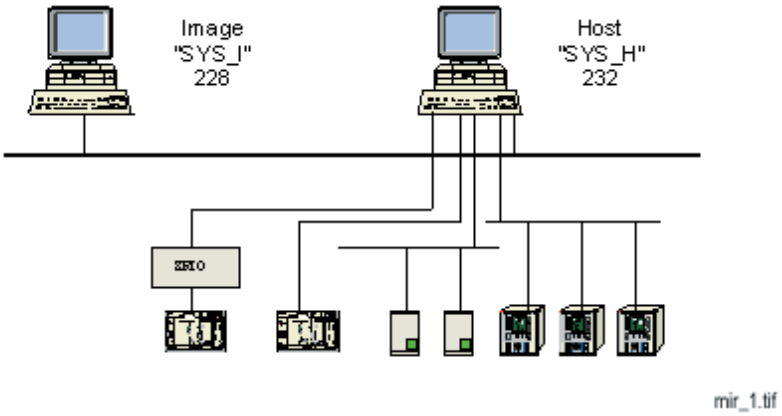

Fig. 3.9.11.1.-1 Simple mirroring system

This is a basic configuration. Process database events of a host base system are mirrored to an image base system.

Configuring the host base system

The configuration of the host base system is described first. Mirroring requires base system node and external application additions in SYS_BASCON.COM. A LAN link, link number 1, is assumed to exist already. In this example, the node number of the host base system is 232 and the node name is SYS_H. The node number of the image base system is 228 and the node name is SYS_I.

A base system node for the image:

```
#CREATE NOD228:B = LIST(-  ;Node for SYS_I
  LI = 1,-
  NN = "SYS_I",-
  SA = 228)
```

An external application to represent the image:

```
#CREATE APL2:B = LIST(-
  TT = "EXTERNAL",-
  NA = "IMAGE1",-
  ND = 228,-
  TN = 1)
```

Mirroring attributes of the host stations can be defined in the user-defined programs of the System Configuration Tool. The definition can be written in the user-defined program of each station, or definitions can be grouped in the user-defined program of the net node. If the System Configuration Tool is not used, the mirroring attributes can be defined in SYS_BASCON.COM. The definition must be done for each mirroring station; the definitions for unit 51 serve as an example in the following.

```
#SET STA51:BMR = "HOST"
#SET STA51:BIS = VECTOR(LIST(APL=2, UN=51))
```

The host application is connected to one image application, so there must be at least two APL-APL servers.

```
#SET APL1:BAA = 2
```

Now the host part of the mirroring configuration is ready.

Configuring the image base system

A base system node for the host:

```
#CREATE NOD232:B = LIST(-  ;Node for SYS_H
  LI = 1,-
  NN = "SYS_H",-
  SA = 232)
```

An external application to represent the host:

```
#CREATE APL2:B = LIST(-
  TT = "EXTERNAL",-
  NA = "HOST1",-
  ND = 232,-
  TN = 1)
```

The mirroring configuration additions of the stations in the image base system can be written in SYS_BASCON.COM.

Mirroring attributes for stations (station 51 as an example):

```
#SET STA51:BMR = "IMAGE"
#SET STA51:BHS = LIST(APL=2, UN=51)
```

The image application receives messages from one host, which defines that the number of APL-APL servers should be at least 2.

```
#SET APL1:BAA = 2
```

Now the configuration of the image system is ready. Both base systems can now be started and the process objects which are of interest are copied from the host to the image.

System messages

Some additional configuration is required to get the system messages from the NET to the image. In the host application, the attribute IS must be defined to introduce the image station which is to receive system messages.

```
#SET APL1:BIS = vector(list(APL=2, UN=91))
```

In the image system the respective station, here unit number 91, must be created to receive system messages from the host.

```
#CREATE STA91:B = LIST(-
  TT = "EXTERNAL",-
  ST = "RTU",-
  MR = "IMAGE",-
  HS = LIST(APL=2, UN=0)
  TN = 91)
```

This unit 91 in the image base system now represents the virtual unit 0 of the host, and system messages from the NET are delivered to the image application.

3.9.11.2. Example 2: Two hosts, redundant image

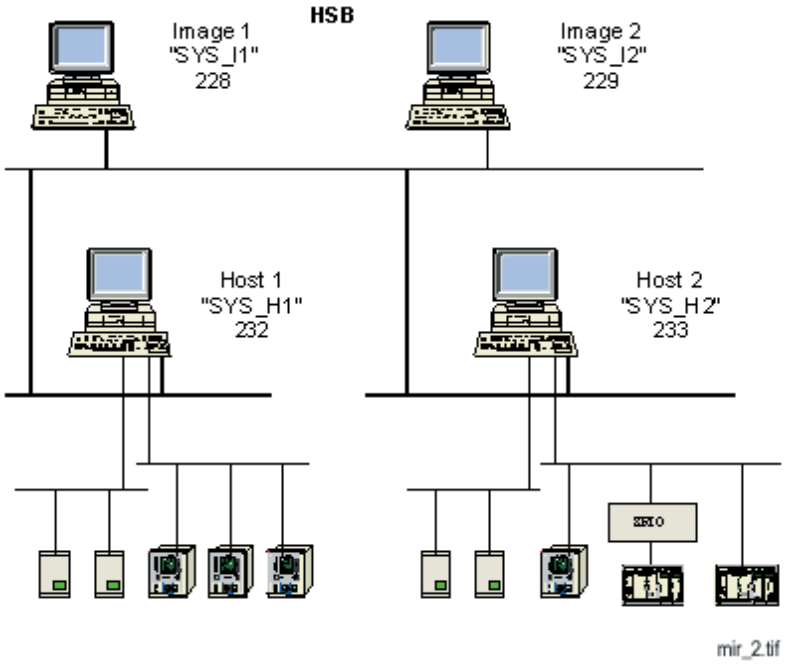

Fig. 3.9.11.2.-1 Redundant image, two hosts

In this example a redundant image base system receives process updates from two host base systems.

- The node number of the image base system 1 is 228 and the node name is SYS_I1.
- The node number of the redundant image base system 2 is 229 and the node name is SYS_I2.
- The node number of the host 1 base system is 232 and the node name is SYS_H1
- The node number of the host 2 base system is 233 and the host name is SYS_H2

The configuration of host base systems is presented first.

Configuring the host base system

The base system nodes for the image base systems are required and must be created in SYS_BASCON.COM of each host base system.

```
#CREATE NOD228:B = LIST(-  ;Node for SYS_I1
  LI = 1,-
  NN = "SYS_I1",-
  SA = 228)

#CREATE NOD229:B = LIST(-  ;Node for SYS_I2
  LI = 1,-
  NN = "SYS_I2",-
  SA = 229)
```

An external application must be created for each image. The following code is added in SYS_BASCON.COM of each host base system. Note the attribute SN which defines the application number of the shadowing partner. Here the external applications 2 and 3 make up a HSB pair.

```
#CREATE APL2:B = LIST(-
  TT = "EXTERNAL",-
  NA = "IMAGE1",-
  ND = 228,-
  SN = 3,-  ;Shadowing partner
  TN = 1)

#CREATE APL3:B = LIST(-
  TT = "EXTERNAL",-
  NA = "IMAGE2",-
  ND = 229,-
  SN = 2,-  ;Shadowing partner
  TN = 1)
```

Mirroring attributes of the host stations can be defined in the user-defined programs of the System Configuration Tool. The definition can be written in the user-defined program of each station, or definitions can be grouped in the user-defined program of the net node. If the System Configuration Tool is not used, the mirroring attributes can be defined in SYS_BASCON.COM. The definition must be done for each mirroring station; below an example of the definitions for unit 51:

```
#SET STA51:BMR = "HOST"
#SET STA51:BIS = VECTOR(LIST(APL=2, UN=51))
```

The host application serves one image application, so there must be at least two APL-APL servers.

```
#SET APL1:BAA = 2
```

Now the mirroring configuration of the hosts is completed.

Configuring the redundant image base system

It is reasonable to make the modifications in one configuration file and then copy the results to the configuration file of the redundant base system.

A node must be created for each host base system.

```
#CREATE NOD232:B = LIST(-  ;Node for host 1 (SYS_H1)
  LI = 1,-
  NN = "SYS_H1",-
  SA = 232)

#CREATE NOD233:B = LIST(-  ;Node for host 2 (SYS_H2)
  LI = 1,-
  NN = "SYS_H2",-
  SA = 233)
An external application must be created for each host base system.
#CREATE APL5:B = LIST(-
  TT = "EXTERNAL",-
  NA = "HOST1",-
  ND = 232,-
  TN = 1)

#CREATE APL6:B = LIST(-
  TT = "EXTERNAL",-
  NA = "HOST2",-
  ND = 233-
  TN = 1)
```

The mirroring configuration additions of the stations for the image base systems can be written in SYS_BASCON.COM.

Mirroring attributes for the stations, here the configuration for stations 51 and 53, is presented as an example. Station 51 receives messages from host 1 and station 53 from host 2.

```
#SET STA51:BMR = "IMAGE"
#SET STA51:BHS = LIST(APL=5, UN=51)

#SET STA53:BMR = "IMAGE"
#SET STA53:BHS = LIST(APL=6, UN=53)
```

The image application receives messages from two hosts, so there must be at least four APL-APL servers.

```
#SET APL1:BAA = 4
```

The mirroring configuration of the image base systems is now ready. All base systems can now be started and process objects can be copied from the hosts to the hot image.

Overlapping unit numbers

In a mirroring system where process events are gathered from several existing hosts it is possible that the same unit number exists in several hosts. Therefore, after the process objects have been copied, the overlapping unit numbers must be changed in the image application. In the host base system this must be noticed when defining mirroring attributes for the station.

For example if unit 2 exists both in host 1 and host 2, the unit number of the process objects from host 2 must be changed to any valid value which is not in use. Here the new unit number in the image application can be 3.

The mirroring definitions for station 2 are:

```
#SET STA2:BMR = "HOST"
#SET STA2:BIS = VECTOR(LIST(APL=2, UN=2))
```

in host 1 and

```
#SET STA2:BMR = "HOST"
#SET STA2:BIS = VECTOR(LIST(APL=2, UN=3))
```

in host 2.

In the image base system a new STA object, station 3, must be created with the appropriate mirroring attribute values:

```
#CREATE STA3:B = LIST(-
  TT = "EXTERNAL",-
  ST = "RTU",-
  MR = "IMAGE",-
  HS = LIST(APL=6, UN=2)
  TN = 3)
```

3.9.11.3. Example 3: Station mapping in a mirroring system

This example illustrates the configuration of a system where the same unit number is used in several hosts and messages coming from these units are delivered to several applications in an image base system. Station mapping feature is required in such configuration.

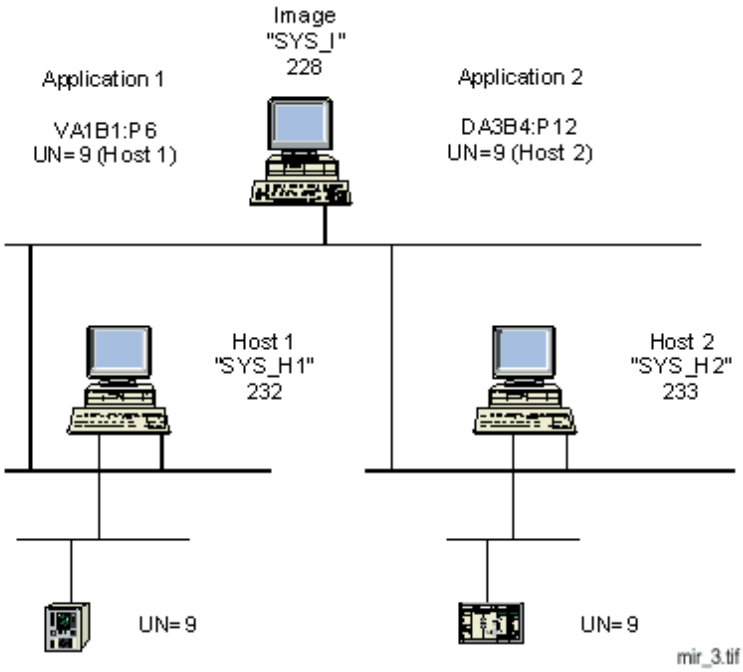

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Fig. 3.9.11.3.-1 Same unit number in two image application

The mirroring configuration procedure is the same as in the previous examples.

Configuring the host base system

Mirroring-related configurations for host 1.

```
#CREATE NOD228:B = LIST(- ;Node for SYS
  LI = 1,-
  NN = "SYS_I",-
  SA = 228)

#CREATE APL2:B = LIST(- ;Mirroring image appl.
  TT = "EXTERNAL",-
  NA = "IMAGE1",-
  ND = 228,-
  TN = 1)

#SET STA9:BMR = "HOST"
#SET STA9:BIS = VECTOR(LIST(APL=2, UN=9))
```

Mirroring-related configurations for host 2.

```
#CREATE NOD228:B = LIST(- ;Node for SYS
  LI = 1,-
  NN = "SYS_I",-
  SA = 228)

#CREATE APL2:B = LIST(- ;Mirroring image appl.
   TT = "EXTERNAL",-
   NA = "IMAGE2",-
   ND = 228,-
   TN = 2)

#SET STA9:BMR = "HOST"
#SET STA9:BIS = VECTOR(LIST(APL=2, UN=9))
```

Number of APL-APL servers.

```
#SET APL1:BAA = 2
```

Configuring the image base system

Mirroring-related configurations for the image.

```
#CREATE NOD232:B = LIST(-  ;Node for SYS
   LI = 1,-
  NN = "SYS_H1",-
  SA = 232)

#CREATE NOD233:B = LIST(-  ;Node for SYS
   LI = 1,-
  NN = "SYS_H2",-
  SA = 233)

#CREATE APL3:B = LIST(-   ;Mirroring host appl.
   TT = "EXTERNAL",-
   NA = "H1",-
   ND = 232,-      ;SYS_H1
   TN = 1)        ;Appl. number

#CREATE APL4:B = LIST(- ;Mirroring host appl.
   TT = "EXTERNAL",-
   NA = "H2",-
   ND = 233,-      ;SYS_H2
   TN = 1)        ;Appl. number
```

Station STA9 receives messages from unit 9 of host 1 and STA109 from unit 9 of host 2.

```
#SET STA9:BMR = "IMAGE"
#SET STA9:BHS = LIST(APL=3, UN=9)

#SET STA109:BMR = "IMAGE"
#SET STA109:BHS = LIST(APL=4, UN=9)
```

Number of APL-APL servers.

```
#SET APL1:BAA = 4
#SET APL2:BAA = 4
```

Station mapping definition connects station STA109 to unit number 9 in application 2.

```
#SET APL2:BST(9) = 109  ;Station mapping
```

3.9.11.4. Example 4: Local mirroring

Both the host and the image are in the same base system. One application is the host application connected to the process, and the other is the image application. In addition to the stations connected to the process, the corresponding image stations must be created as well. In this example, the image station number is 1000 + host stations number.

Mirroring configuration of the host

Mirroring attributes of the host stations can be defined in the user-defined programs of the System Configuration Tool. The definition can be written in the user-defined program of each station, or definitions can be grouped in the user-defined program of the net node. The definition must be done for each mirroring station. See an example of the definitions for unit 51 below.

```
#SET STA51:BMR = "HOST"
#SET STA51:BIS = VECTOR(LIST(APL=2, UN=1051))
```

Mirroring configuration of the image

Mirroring attributes of the image stations can be defined in the configuration file SYS_BASCON.COM.

The station 1051 receives messages from the host station 51 in application 1. Therefore, the mirroring attributes for station 1051 are the following.

```
#SET STA1051:BMR = "IMAGE"
#SET STA1051:BHS = LIST(APL=1, UN=51)
```

3.9.11.5. Example 5: Hierarchical mirroring

In this example, the node number of the substation base system is 232, and the node name is SUBS. The regional control center base system node number is 230, and the node name is REGIONCC. Finally, the main control center base system node number is 228, and the node name is MAINCC.

Mirroring attributes can be defined in the user-defined programs of the System Configuration Tool. The definition can be written in the user-defined program of each station, or definitions can be grouped in the use-defined program of the net node. The definition must be done for each mirroring station. See an example of the definitions for unit 51 below.

Mirroring definitions in the substation:

This is the host base system.

```
#SET STA51:BMR = "HOST"
#SET STA51:BIS = VECTOR(LIST(APL=2, UN=51))
```

Create an external application (image).

```
#CREATE APL2:B = LIST(-
  TT = "EXTERNAL",-
  NA = "REGION",-
  ND = 230,-
  TN = 1)
```

Create a node for the image.

```
#CREATE NOD230:B = LIST(-  ;Node for the Regional Control Center
  LI = 1,-
  DI = 10,-
  DT = 5,-
  DF = 1,-
  NN = "REGIONCC",-
  SA = 230)
```

Now the mirroring configuration of the substation is ready.

Mirroring definitions of the regional control center

The units in the regional control center can both receive messages from the substation (the host) and transmit messages to the main control center (image). The mirroring role MR of such stations must be "BOTH".

Mirroring attributes for station 51:

```
#SET STA51:BMR = "BOTH"
#SET STA51:BHS = LIST(APL=2, UN=51)
#SET STA51:BIS = VECTOR(LIST(APL=3, UN=51))
```

Create two external applications, one for the image and another for the host.

```
#CREATE APL2:B = LIST(-
  TT = "EXTERNAL",-
  NA = "SUBS",-
  ND = 232,-
  TN = 1)

#CREATE APL3:B = LIST(-
  TT = "EXTERNAL",-
  NA = "MAIN",-
  ND = 228,-
  TN = 1)
```

Create nodes.

```
#CREATE NOD228:B = LIST(-  ;Node for the Main Control Center
  LI = 1,-
  DI = 10,-
  DT = 5,-
  DF = 1,-
  NN = "MAINCC",-
  SA = 228)

#CREATE NOD232:B = LIST(-  ;Node for the Substation
  LI = 1,-
  DI = 10,-
  DT = 5,-
  DF = 1,-
  NN = "SUBS",-
  SA = 232)
```

Now the mirroring configuration of the regional control center is ready.

Mirroring definitions of the main control center

Image configuration additions can be written in SYS_BASCON.COM of the main control center base system. The node number of the base system is 228, and the node name is MAINCC.

Mirroring attributes for station 51

```
#SET STA51:BMR = "IMAGE"
#SET STA51:BHS = LIST(APL=2, UN=51
```

Create an external application for the regional control center (host).

```
#CREATE APL2:B = LIST(-
  TT = "EXTERNAL",-
  NA = "REGION",-
  ND = 230,-
  TN = 1)
```

Create a node for the host

```
#CREATE NOD230:B = LIST(-  ;Node for the Regional Control Center
  LI = 1,-
  DI = 10,-
  DT = 5,-
  DF = 1,-
  NN = "REGIONCC",-
  SA = 230)
```

Now the main control center configuration is ready as well.

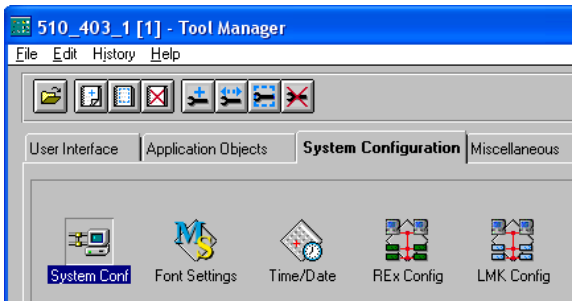
4. Configuration tools

4.1. System Configuration Tool

4.1.1. Starting System Configuration Tool

To start the System Configuration Tool, follow the steps given below:

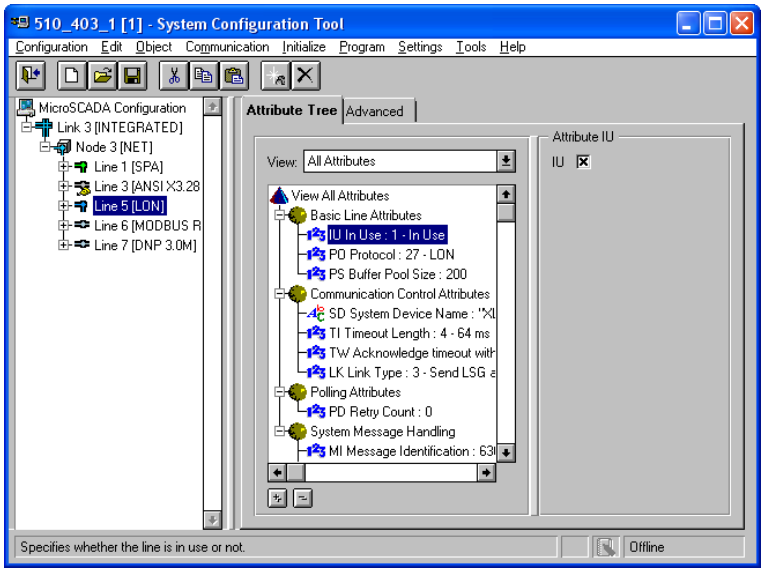
1. Click the System Configuration tab in the MicroSCADA Pro **Tool Manager** dialog.
2. Double-click the **System Conf** tool icon, as shown in Fig. 4.1.1.-1.



A051809

Fig. 4.1.1.-1 System Configuration Tool icon

The **System Configuration Tool** dialog includes a menu bar and a tool bar. To make the tool bar visible, select **Settings > Tool bar Visible**. Below the tool bar, there is an object tree on the left side, an attribute tree in the middle and an attribute editing area on the right side. In addition to these, there is an information text bar and a status bar at the bottom of the page, as shown in Fig. 4.1.1.-2.


510_403_1 [1] - System Configuration Tool
Configuration Edit Object Communication Initialize Program Settings Tools Help
MicroSCADA Configuration
Link 3 [INTEGRATED]
Node 3 [NET]
Line 1 [SPA]
Line 3 [ANSI X3.28
Line 5 [LON]
Line 6 [MODBUS R
Line 7 [DNP 3.0M]
Attribute Tree
Advanced
Attribute IU
View: All Attributes
IU
View All Attributes
Basic Line Attributes
IU In Use : 1 - In Use
PO Protocol : 27 - LON
PS Buffer Pool Size : 200
Communication Control Attributes
TI Timeout Length : 4 - 64 ms
Polling Attributes
PD Retry Count : 0
System Message Handling
Specifies whether the line is in use or not.
Offline

A051810

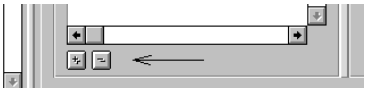
Fig. 4.1.1.-2 System Configuration Tool dialog

4.1.2. Handling objects and attributes

When you select an object from the object tree and if **All Attributes** is selected as the **View** option, all the attributes linked to it are shown in the attribute tree (as shown in Fig. 4.1.2.-1). The working order is from left to right. After selecting an object in the object tree, you can select an attribute in the attribute tree and edit the selected attribute in the attribute editing area.

A tree can be expanded by clicking the + sign on the left or by double-clicking the text area on the right. Likewise, the tree can be collapsed by clicking the **-** sign or double-clicking the text area. The **-** sign indicates that the branch of the tree cannot be expanded any further.

The whole attribute tree can be expanded and collapsed by using the + and **-** buttons that are located below the tree, as shown in Fig. 4.1.2.-1.



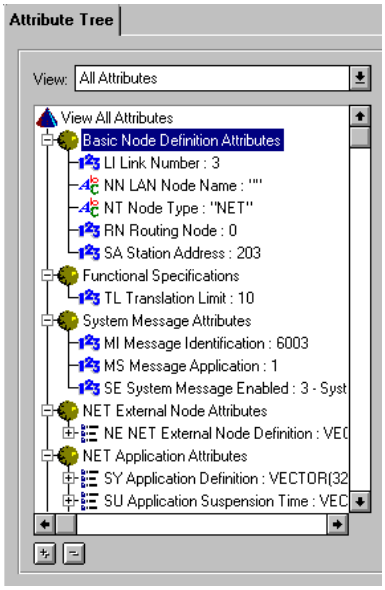
A051808

Fig. 4.1.2.-1 Expand and collapse buttons for the attribute tree

4.1.2.1. Changing attribute values

When you select an object from the configuration tree and select **All Attributes** as the **View** option, all the attributes linked to that object are displayed in the attribute tree.

The attribute tree consists of attribute groups, which can be expanded to show all the attributes in the group. The attribute tree can be expanded and collapsed by using the **+** and **-** buttons that are situated under the tree. The attributes are illustrated by an icon, a two-letter abbreviation, name and the valid value.


Attribute Tree
View: All Attributes
View All Attributes
Basic Node Definition Attributes
LI Link Number : 3
NN LAN Node Name : ""
NT Node Type : "NET"
RN Routing Node : 0
SA Station Address : 203
Functional Specifications
TL Translation Limit : 10
System Message Attributes
MI Message Identification : 6003
MS Message Application : 1
SE System Message Enabled : 3 - Syst
NET External Node Attributes
NE NET External Node Definition : VEC
NET Application Attributes
SY Application Definition : VECTOR(32
SU Application Suspension Time : VEC

A051811

Fig. 4.1.2.1.-1 MicroSCADA Pro Configuration item attributes in the expanded attribute tree

The attributes are given default values by the tool. Most of the values can be changed.

If the value in the editing area is dimmed, editing action will not be allowed.

The working order is from left to right. Changing of value in the attribute tree requires the following steps:

1. Select an object in the **Object Tree**.
2. Click the **+** button under the attribute tree to expand all the attribute groups.
3. Select the attribute that you want to configure.
4. Change the value in the editing area.
5. Press **Enter**.

In the attribute editing area, the on/off values have a check box. A clear check box indicates Off (0) and a selected check box indicates On (1). For integer values, there is a numeric spin box in the editing area, as shown in Fig. 4.1.2.1.-2.

The attribute tree is updated, when changes are made in the editing area.

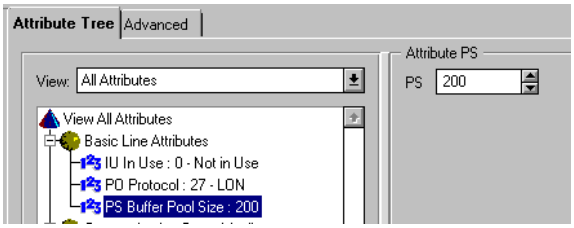


Fig. 4.1.2.1.-2 Editing the PS attribute value with the numeric spin box

4.1.2.2. NET Node station address

For communication units, the default SA attribute value is 200 + node number. If node number is set bigger than 55, the default SA attribute value set by the System Configuration Tool is 255.

4.1.3. Saving configurations

If a configuration from a former MicroSCADA Pro release is read into the System Configuration Tool, it can be saved with the **Configuration > Save Active** command. The configuration is saved in the following default files: Sysconf.ini and Signals.ini.

The configuration is available when MicroSCADA Pro 8.4.2 or subsequent sys_bascon.com (sys_bascon$com) template is in use.

4.1.4. Creating a new configuration

From the menu bar, select **Configuration > New**. This command opens a configuration that is delivered with the System Configuration Tool. It includes an Object tree with Link 3 (INTEGRATED) and Node 3 (NET), as shown in Fig 4.1.4.-1.

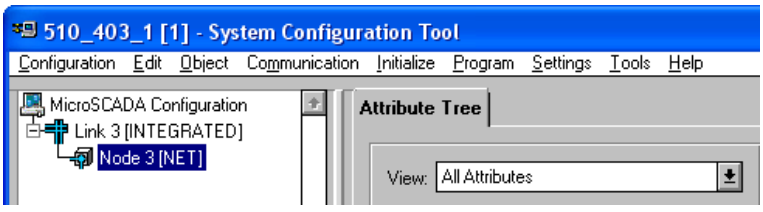


Fig. 4.1.4.-1 New configuration

If there is already a configuration open in the tool, the entire configuration data is cleared from the tool and the contents of the Object tree is replaced with the default configuration. To save the open configuration, copy or rename the Sysconf.ini and Signals.ini files in the sys/active/sys_ folder.

4.1.4.1. Adding new objects

1. From the object tree, select a parent object for the new object, as shown in Fig. 4.1.4.1.-1.

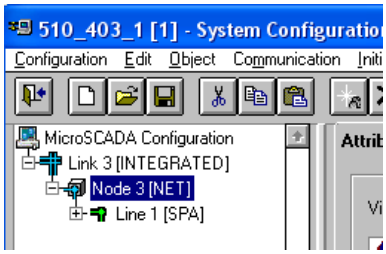


Fig. 4.1.4.1.-1 Node 3 (NET) selected to be the parent object

2. After selecting a parent object, there are three ways of adding objects to the configuration.

   Use one of the following methods:

   - Keyboard command Ctrl+N
   - Menu bar command **Object > New**, as shown in Fig. 4.1.4.1.-2

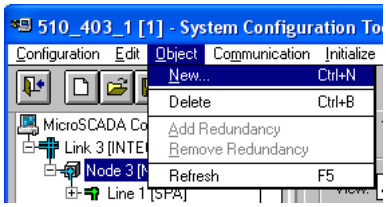
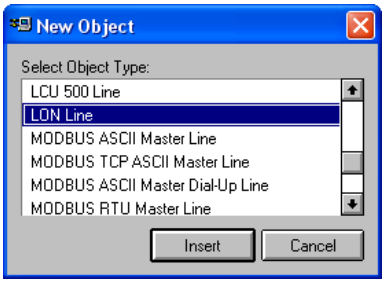


Fig. 4.1.4.1.-2 New object is added by using the menu bar command

   - Click the **Object** creation tool icon in the tool bar

Fig. 4.1.4.1.-3 New object icon

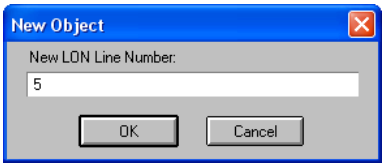
3. Select the object type and click **Insert**.



A051816

Fig. 4.1.4.1.-4 LON Line is added to the configuration

4. Enter the object number in the text box and click **OK**, as shown in Fig. 4.1.4.1.-5.



A051817

Fig. 4.1.4.1.-5 Number five is entered for the new line object

The new object is added to the object tree.

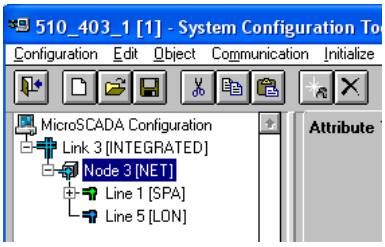


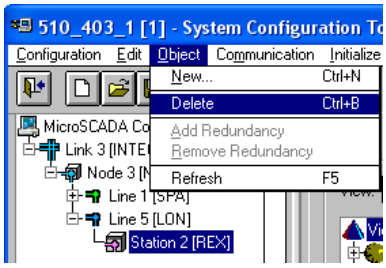
Fig. 4.1.4.1.-6 The new line in the object tree

4.1.4.2. Deleting objects

Objects can be deleted by following the steps given below:

1. Select the object from the Object tree.
2. Click **Object** menu from the menu bar.
3. Select the object and click **Delete**.

If the object includes user-defined SCIL programs or signals, they are deleted as well.



A051819

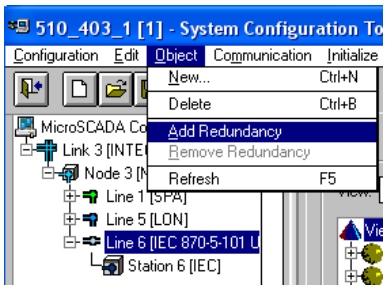
Fig. 4.1.4.2.-1 Station 2 is deleted

The main object (MicroSCADA Pro Configuration object) cannot be deleted.

4.1.4.3. Adding a redundant line

The tool supports adding redundant line for IEC 60870-5-101 and RP570 slave lines.

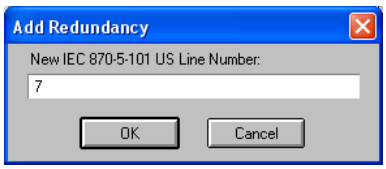
1. Select the IEC 870-5-101 Slave Line or RP570 Slave Line from the object tree.
2. Select **Object > Add Redundancy**, as shown in Fig. 4.1.4.3.-1.



A051820

Fig. 4.1.4.3.-1 Adding a redundant line

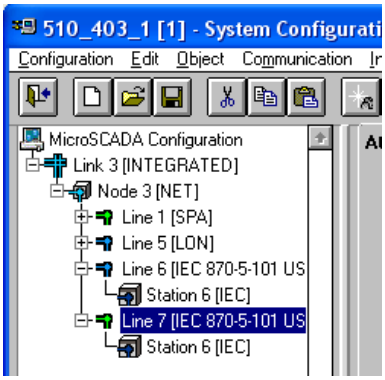
3. Enter the line number of the redundant line in the field, as shown in Fig. 4.1.4.3.-2.



A051821

Fig. 4.1.4.3.-2 Enter the line number of the redundant line

The redundant line is added to the object tree, as shown in Fig. 4.1.4.3.-3.

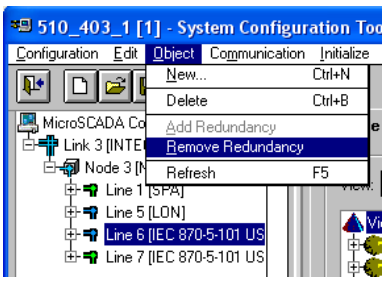


A051822

Fig. 4.1.4.3.-3 Redundant line configuration

4.1.4.4. Deleting a redundant line

1. To delete a redundant line (IEC 870-5-101 slave or RP570 slave), select the line you want to delete, as shown in Fig. 4.1.4.4.-1.
2. Select **Object > Remove Redundancy** from the menu bar, as shown in Fig. 4.1.4.4.-1.



A051823

Fig. 4.1.4.4.-1 Deleting a redundant line

4.1.5. Configuring dial-up

Some communication lines, for example ANSI X3.28, can be configured to use a dial-up communication. Dial-up protocols are identified in the New Object list when communication line is added to the configuration. In the object tree, an icon is used for dial-up representation and a set of Autodialling attributes can be seen in the attribute tree for the selected dial-up communication line, as shown in Fig. 4.1.5.-1.

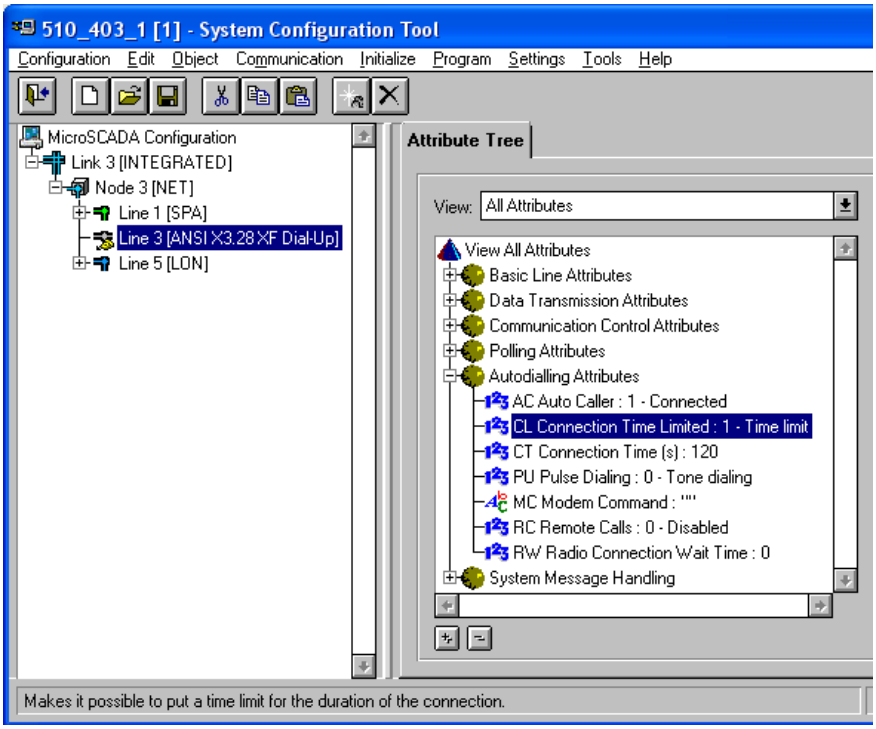

510_403_1 [1] - System Configuration Tool
Configuration Edit Object Communication Initialize Program Settings Tools Help
MicroSCADA Configuration
Link 3 [INTEGRATED]
Node 3 [NET]
Line 1 [SPA]
Line 3 [ANSI X3.28 XF Dial-Up]
Line 5 [LON]
Attribute Tree
View: All Attributes
View All Attributes
Basic Line Attributes
Data Transmission Attributes
Communication Control Attributes
Polling Attributes
Autodialling Attributes
AC Auto Caller : 1 - Connected
CL Connection Time Limited : 1 - Time limit
CT Connection Time (s) : 120
PU Pulse Dialing : 0 - Tone dialing
MC Modem Command : ""
RC Remote Calls : 0 - Disabled
RW Radio Connection Wait Time : 0
System Message Handling
Makes it possible to put a time limit for the duration of the connection.
A060290

Fig. 4.1.5.-1 Dial-up configuration

In on-line mode, the auto-caller state information is displayed on the Diagnostics page. It can be used for the dial-up communication line.

If the specified communication port does not contain a modem or the modem is switched off, the communication line cannot be successfully configured into the communication system (PC-NET). When this occurs, the status codes `10003 NETP_TIMEOUT_WHILE_WAITING_ACKNOWLEDGE` or `152 SCIL_NET_COMMUNICATION_TIMEOUT` are displayed in the MicroSCADA Pro Notification dialog during the configuration.

4.1.6. Saving as a default configuration

The default configuration is stored in a configuration file called Sysconf.ini.

To open the default configuration file, select **Configuration > Open Active** Active. The default configuration is loaded in the tool.

The tool opens in the off-line mode, which is shown in the status bar.

To save a configuration as the default configuration, select **Configuration > Save Active**. The configuration currently open in the tool is saved as the default configuration in the Sysconf.ini file.

The configuration can be saved at any time and this action can be done in both on-line and off-line mode.

In on-line mode, only the objects that are **In Use**, are saved with **Configuration > Save Active** command.

4.1.7. Online configuration

The online configuration is the current running configuration in the MicroSCADA Pro system.

4.1.7.1. Loading online configuration

You can load the current MicroSCADA Pro system configuration in the tool either all at once or stepwise, node by node.

To load the current configuration all at once, select **Configuration > Open Online > All**, as shown in Fig. 4.1.7.1.-1.

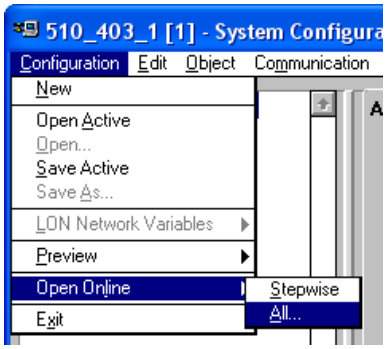


Fig. 4.1.7.1.-1 Open Online configuration 1

Loading the online configuration all at once can be a lengthy operation under following circumstances:

- When the configuration consists a great amount of devices
- When number of devices are located behind slow communication lines or do not respond at all

Thus it is recommended to open the current online configuration stepwise, for example, the actual loading is not done until the node is expanded. To load the current configuration step by step, select **Configuration > Open Online > Stepwise**, as shown in Fig. 4.1.7.1.-2.

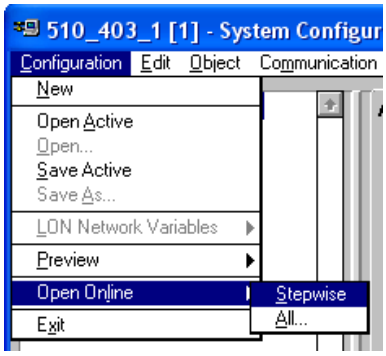


Fig. 4.1.7.1.-2 Open Online configuration 2

After either of the above action, the System Configuration Tool is changed to the on-line mode. The background color of the object and attribute trees are set to "Lavender" and the text in the lower-right corner is changed to “Online” when the online mode is selected.

Under MicroSCADA Configuration node there is a node called Station Type Definitions, as shown in Fig. 4.1.7.1.-3. This object includes all the different station types, which are displayed when the Station Type Definitions node is expanded. Deletion of this object is not possible.

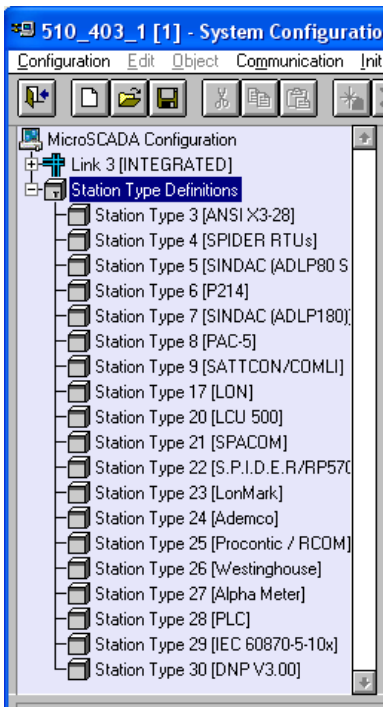


Fig. 4.1.7.1.-3 Station type definitions in the on-line configuration

4.1.7.2. Saving online configuration

If the online configuration is loaded using the method **Configuration > Open Online > All**, it can be saved using the command **Configuration > Save Active**. The following notification dialog is displayed on the screen:

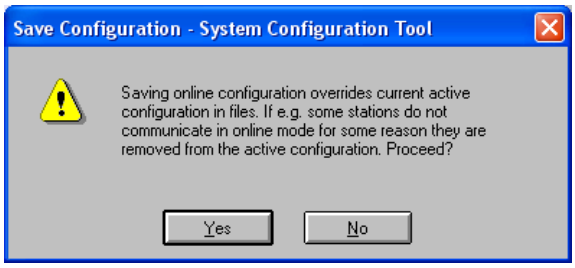

Save Configuration - System Configuration Tool
Saving online configuration overrides current active configuration in files. If e.g. some stations do not communicate in online mode for some reason they are removed from the active configuration. Proceed?
Yes
No

Fig. 4.1.7.2.-1 Dialog informing the user that saving online configuration overrides current configuration files

- Click **Yes** to override the current active configuration in the System Configuration Tool and save the online configuration as the default configuration.
- Click **No** to cancel the saving operation. If the menu bar command **Configuration > Save Active** is selected, the configuration must include a Link object and a NET Node object related to the Link.

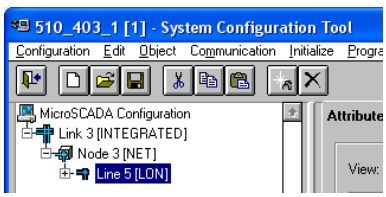
If the Link object and/or the NET Node object are not present, the PC-NET does not start up successfully. Therefore, the configuration becomes invalid and cannot save with the **Save > Active** command.

4.1.8. Taking configuration in use and out of use

When taking LONWORKS lines and stations in use in the PC-NET, it is essential for the line to be taken in use before any station (on that specific line) is taken in use. Likewise, all the stations must be taken out of use before the line is taken out of use.

To take the configuration in use, it is required to change the IU attribute values to In Use mode in the System Configuration Tool.

1. From the menu bar, select **Configuration > Open Active** if the configuration is not open already.
2. In the Object tree, select the line you want to take in use.

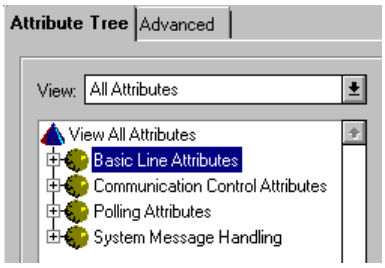


A051825

Fig. 4.1.8.-1 LON line number five is selected in the Object tree

3. Double-click the text **Basic Line Attributes** or click the + sign in the Attribute tree.

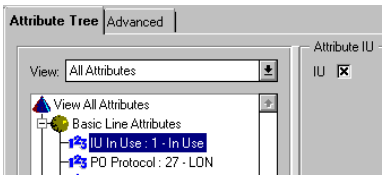
   This expands the **Basic Line Attributes** group and shows all the attributes in it.



A051826

Fig. 4.1.8.-2 Line five (LON) attribute groups

4. If the IU (In Use) attribute value is 0 (Not In Use), change it to 1 (In Use) in the following way:
   - In the Attribute tree, click the **IU attribute line**.
   - In the attribute editing area, select the IU check box (In Use state).



A051827

Fig. 4.1.8.-3 IU Attribute in the In Use (1) state

5. Select **Configuration > Save Active** from the menu bar.

After you have taken the line in use, you can take the stations in that line in use as well.

4.1.9. Reallocating stations

It is possible to cut, copy and paste the already defined objects in the configuration tree. When you cut an object, it is also deleted from the configuration tree.

During the cutting/copying and pasting action, all the related information is copied and reallocated. This includes attribute values, possible user-defined SCIL programs (stations, NET Lines and NET Nodes) and signals (REx, LMK and SPA points).

4.1.9.1. Cutting and copying stations

1. Select the object you want to cut or copy from the configuration tree.
2. Select **Edit > Cut** or **Edit > Copy** from the menu bar.

The selected object is cut or copied to the clipboard.

During cutting/copying the contents of the signal data for the REx, LMK, SPA and LON, Clock Master devices as well the data structure is assigned to the clipboard.

Cutting an object is not possible if the selected object includes child objects.

4.1.9.2. Pasting stations

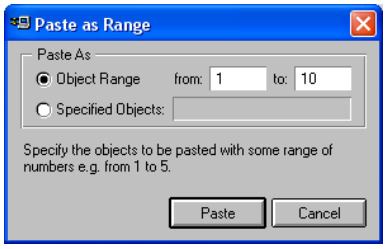
1. In the configuration tree, select the parent object for the object on the clipboard.
2. Select **Edit > Paste** from the menu bar.

The pasted object is a child object for the selected parent object.

During the **Edit > Paste** sequence, the possible signal data is taken into use from the clipboard. This concerns REx, LMK, SPA and LON Clock Master devices only.

The System Configuration Tool guards against incorrect configuration: it is not possible to paste a SPA device directly under a LON line (an LMK device is needed) or to paste an LMK device under a SPA line.

The configuration object, that is copied into the clipboard, can be pasted several times. The pasted object number collection is based either on the definition of the minimum and maximum object numbers (for example from 1 to 10) or on the definition of individual object numbers (for example 4, 5, 8, 10). The **Paste As Range** function can be found in the **Edit** menu.



A051851

Fig. 4.1.9.2.-1 Minimum object number is defined to be 1 and the maximum object number 10

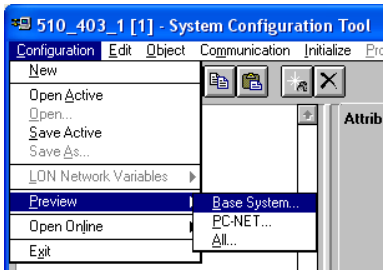
If the copied object includes a set of child objects (for example, copied LMK station includes several SPA stations), the pasting of the object (LMK station) does not include pasting of the child objects (SPA stations). The child objects are required to copy separately.

System Configuration Tool includes error handling during the pasting of objects.

4.1.10. Previewing

The contents of a currently open configuration file can be displayed in the tool using the **Preview** function. In this function, the data is shown in SCIL clauses.

To show the configuration data, select **Configuration > Preview**, as shown in Fig. 4.1.10.-1. The SCIL clauses are displayed in the SCIL Editor.



A051625

Fig. 4.1.10.-1 Preview options

SCIL programming is not possible by using the **Preview** function.

4.1.11. User-defined programs

It is possible to make user-defined SCIL programs for the NET Node, NET Line and Stations. With these programs, you can modify lines and process units with features, which are not yet supported by the configuration tool. For the NET, you can create protocols and devices, which are not yet supported for the lines in the System Configuration Tool.

A051626

Fig. 4.1.11.-1 Symbol for the user-defined programs is disabled

In the status bar of the System Configuration Tool, there is information for user-defined SCIL programs with the following meanings:

- If an enabled symbol exists, the selected object includes a user-defined SCIL program.
- If a disabled symbol exists, it is possible to include a user-defined SCIL program for the selected object, but nothing has been attached yet.
- If no symbol exists, it is not possible to include a user-defined SCIL program for the selected object.

1. Select the object to be modified.

   If the symbol exists in the status bar, you can modify the SCIL program or create a new one.

2. Select **Program > User-Defined**, as shown in Fig. 4.1.11.-2.

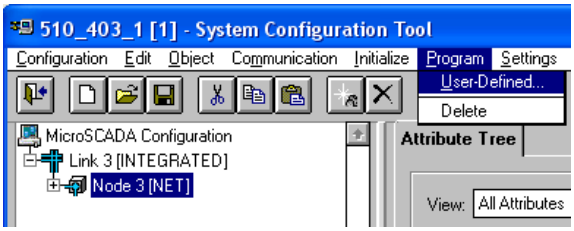


Fig. 4.1.11.-2 SCIL Editor is opened

3. Edit your program using the variables listed in the comments of the program.

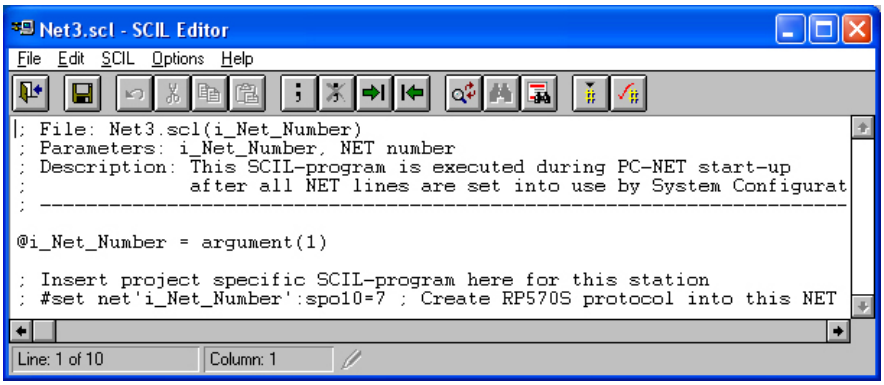

Net3.scl - SCIL Editor
File Edit SCIL Options Help
; File: Net3.scl(i_Net_Number)
; Parameters: i_Net_Number, NET number
; Description: This SCIL-program is executed during PC-NET start-up
; after all NET lines are set into use by System Configurat
@i_Net_Number = argument(1)
; Insert project specific SCIL-program here for this station
; #set net'i_Net_Number':spo10=7 ; Create RP570S protocol into this NET
Line: 1 of 10
Column: 1
A051628

Fig. 4.1.11.-3 Net3.scl file in the SCIL Editor

4. Update and exit the program editor.

4.1.12. Sending general object handling command

This attribute is included in the System Configuration Tool, when the tool is used in the online mode.

1. Select a REX station in the **Object tree**.
2. Select **Tools > General Object Handling Command** to open the **General Object Handling Command** dialog, as shown in Fig. 4.1.12.-1 and Fig. 4.1.12.-2.

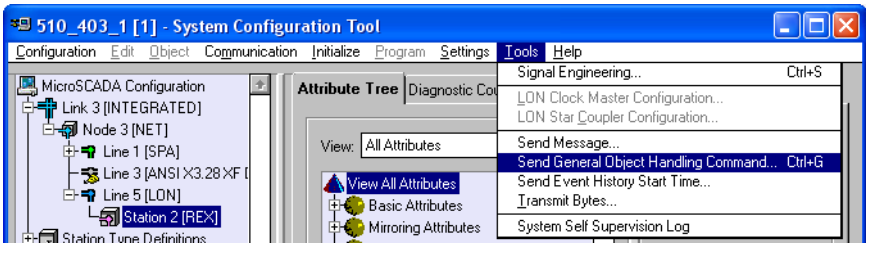


Fig. 4.1.12.-1 General Object Handling Command dialog is displayed

3. Type the appropriate values.
4. Click **Send** to send command to the selected REX Station. The **Close** button closes the dialog without sending any command.

Example:

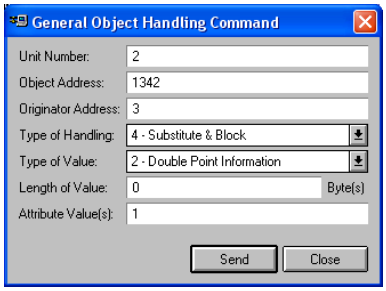


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Fig. 4.1.12.-2 General Object Handling Command dialog with example values

If you enter the same value definitions that you can see in the dialog above, in Fig. 4.1.12.-2, and click **Send** or press **Enter** on the keyboard, the following SCIL command is send to the REX station number one:

```
#SET STA1:SGO = (1, 1342, 3, 4, 2, 0, 1)
```

4.1.13. Defining general environment definitions

The attribute tree definitions and PC-NET start-up delay time can be set in the Environment dialog.

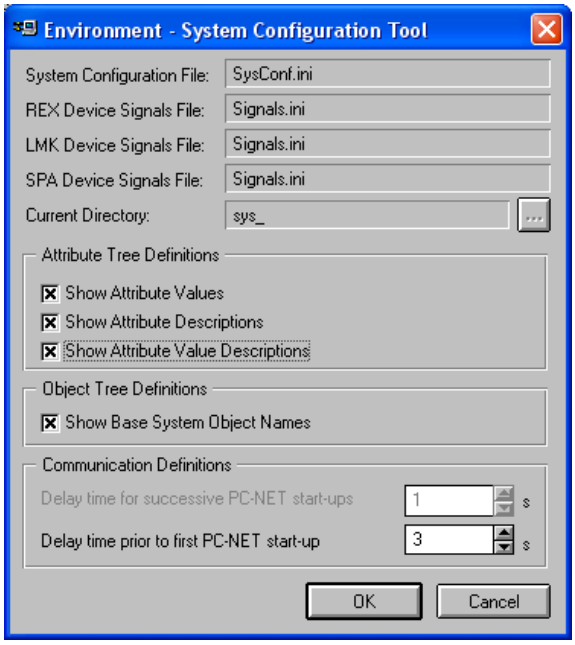

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Fig. 4.1.13.-1 Environment dialog of System Configuration Tool

The setting of delay time for successive PC-NET start-ups has meaning only when more than one PC-NET is installed, so in a single PC-NET configuration the setting is disabled in the dialog.

4.1.14. System monitoring

System Self Supervision is always dedicated into certain MicroSCADA Pro application, which includes sets of command procedures, event channels, time channels, process objects, data objects and parameter files. System Self Supervision functionality can be enabled in the MicroSCADA Pro application by using either of the following ways:

- By installing the first picture function from the LIB 500 System Self Supervision package
- By selecting the enabled state from the **System Self Supervision** dialog in the System Configuration Tool.

To open the System Self supervision dialog, select **Settings > System Self Supervision** in the System Configuration Tool, as shown in Fig 4.1.14.-1.

System Self Supervision
When system configuration data is saved, the constructing of supervision routing objects for System Self Supervision can be enabled or disabled into process database of current application.
Enabled
Create supervision routing objects
Remove supervision routing objects
Disabled
Remove supervision routing objects
Run-time supervision routing enabled
OK
Cancel

A051829

Fig. 4.1.14.-1 Enabling and disabling the system self-supervision

When the System Self Supervision functionality is enabled in MicroSCADA Pro application, the System Configuration Tool does not create supervision routing objects for all the included configuration objects by default. Hence, the user need to select the appropriate option from the dialog. To remove the supervision routing objects from the previously included configuration objects, it is also required to set that option in the System Self Supervision dialog.

If no picture function is installed from the LIB 500 System Self Supervision package when System Configuration Tool is accessed for the first time and this dialog is opened, the System Self Supervision is in the disabled state. By default, removing supervision routing from all the previously included configuration objects requires to set that option in the **System Self Supervision** dialog.

If the **System Self Supervision** dialog is accessed when previous SYS_BASCON.COM template is being used, an information dialog is displayed. To enable the system self-supervision routing, it is required to include a new attribute,

B_SSS_MECH_IN_USE in the base system object definition (SYS:B). An example of this attribute can be found from the new template in the file SYS_BASCON $COM.

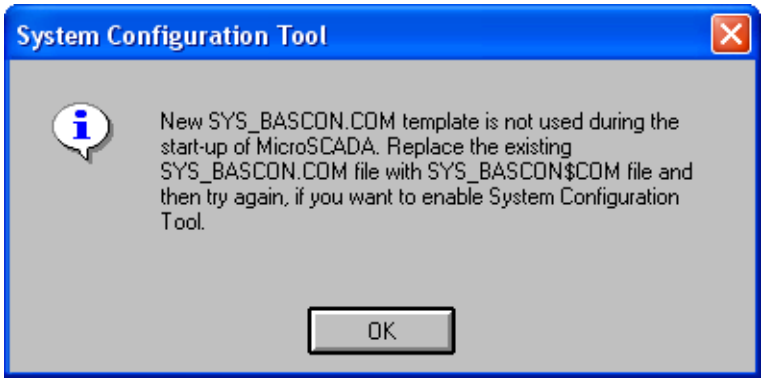
System Configuration Tool
New SYS_BASCON.COM template is not used during the start-up of MicroSCADA. Replace the existing SYS_BASCON.COM file with SYS_BASCON$COM file and then try again, if you want to enable System Configuration Tool.
OK
A051830

Fig. 4.1.14.-2 Dialog asking to replace the current SYS_BASCON.COM template to enable the system self-supervision

When the old SYS_BASCON.COM is used during the start-up of MicroSCADA Pro, the editing of the System Self Supervision dialog is disabled.

If you are using a new SYS_BASCON.COM template during the start-up of MicroSCADA Pro, you can stop and start the run-time supervision routing in the application. To stop and start the run-time supervision routing, use Run-time supervision routing enabled check box in the bottom of **System Self Supervision** dialog. An information dialog displays the message whether the action was successful or not.

4.1.14.1. Supervision log

The System Configuration Tool includes access to Supervision Log. To enter the **Supervision Log** dialog, select **Tools > Supervision Log** from the menu bar.

The **Supervision Log** displays all the different events in MicroSCADA Pro and the Windows system. Different log types are:

- Common system messages
- Unknown process objects
- System events from operating system
- Security events from operating system
- Application events from operating system

To select the log type, click **Log** from the menu bar and select the appropriate log type from the menu items. For the events shown in the view, there is a possibility to set a different filter condition, for example, events from a certain station number.

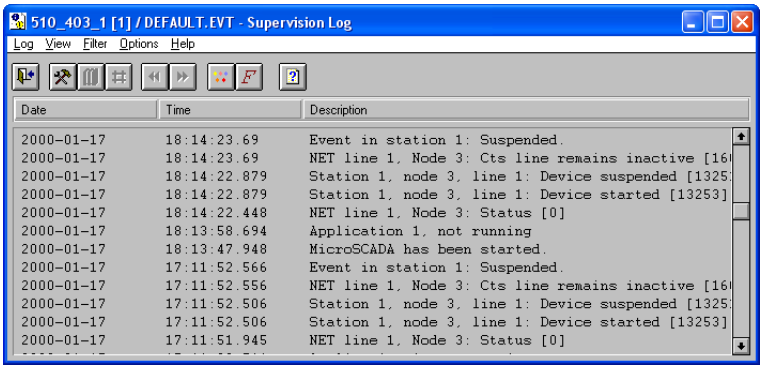
510_403_1 [1] / DEFAULT.EVT - Supervision Log
Log View Filter Options Help
Date Time Description
2000-01-17 18:14:23.69 Event in station 1: Suspended.
2000-01-17 18:14:23.69 NET line 1, Node 3: Cts line remains inactive [16
2000-01-17 18:14:22.879 Station 1, node 3, line 1: Device suspended [1325
2000-01-17 18:14:22.879 Station 1, node 3, line 1: Device started [13253]
2000-01-17 18:14:22.448 NET line 1, Node 3: Status [0]
2000-01-17 18:13:58.694 Application 1, not running
2000-01-17 18:13:47.948 MicroSCADA has been started.
2000-01-17 17:11:52.566 Event in station 1: Suspended.
2000-01-17 17:11:52.556 NET line 1, Node 3: Cts line remains inactive [16
2000-01-17 17:11:52.506 Station 1, node 3, line 1: Device suspended [1325
2000-01-17 17:11:52.506 Station 1, node 3, line 1: Device started [13253]
2000-01-17 17:11:51.945 NET line 1, Node 3: Status [0]

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Fig. 4.1.14.1.-1 MicroSCADA Pro Supervision Log in the System Configuration Tool

4.1.14.2. Classic monitor supervision

When MONn:Bnn attributes are used as a source for monitor supervision, the following semantics can be used to provide additional information beside the monitor symbol:

Table 4.1.14.2.-1 Monitor mapping of an application

Attribute	Description	Functionality
TT	Translation type	Translation type of the monitor
DT	Display type	Display type of the monitor
LA	Language	Language of the operator

When monitor mapping of application (APLn:BMONnn) is used as a source for monitor supervision, the following semantics is found from the attribute value:

Table 4.1.14.2.-2 Semantics found from the attribute value

Value	Functionality
-1	Monitor not in use
> 0 and <151	Monitor in use

Example:

A051832

Fig. 4.1.14.2.-1 Supervised monitor example

4.1.15. Signal engineering

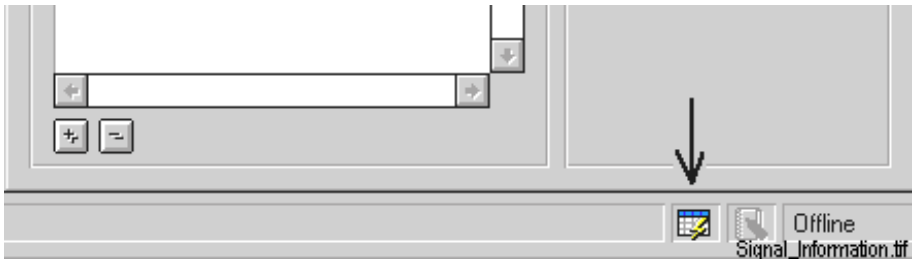
System Configuration Tool is integrated to subtools for handling signal information for devices. For each device type, there is a corresponding configuration tool for managing signal information. To start the subtools, select **Tools > Signal Engineering** from the menu bar. The configuration dialog opens. It includes all the signal information for the selected station.

To transfer the signal information from the subtool, select **Configuration/File > Update** from the subtool's menu bar. Information is also transferred to the System Configuration Tool, when **Configuration/File > Exit** is selected. In each of the subtools, there are options to cut, copy and paste signal information.

4.1.15.1. Indicator for signal information

In the status bar of the System Configuration Tool, there is an indicator for signal information with the following meanings:

- If there is an enabled symbol, the selected object includes signal information.
- If there is a disabled symbol, it is possible to include signal information for the selected object, but no signals are created yet.
- If there is no symbol, it is not possible to include signal information for the selected object.



A051833

Fig. 4.1.15.1.-1 Indicator shows that the selected object includes signal information

The following features are common to all devices:

- When you select a station in the configuration tree, the attribute area is updated.
- Select **Tools > Signal Engineering** from the menu bar to see the signal information of the selected station. This operation opens the station Configuration page.
- You can manage the signals with **Add**, **Edit** and **Delete** buttons in the Configuration page. Signal items can be edited only when the System Configuration tool is in offline mode. In online mode the buttons **Add**, **Edit** and **Delete** are disabled and the signal configuration can be viewed but not modified.

Add/Edit

Add and **Edit** buttons open the signal Add/Edit dialog for entering or changing the signal information. The user interface of this dialog depends on the station type.

OK

The **OK** button accepts the entered values into the signal list of the device and closes the Add/Edit dialog.

Cancel

The **Cancel** button cancels the add/edit operation and closes the Add/Edit dialog.

Apply

The **Apply** button accepts the entered values into the signal list without closing the dialog.

- When a device configuration tool is closed, the signals related to the selected device are transferred to the System Configuration tool. When **Configuration > Save Active** is selected, these signals are saved into the configuration files and they become a part of the configuration data. The device signals are interpreted automatically when the NET communication is starting.
- You can see the SCIL commands which are created from the device signals by selecting **Configuration > Preview** from the System Configuration tool menu bar.

Editing of signal information requires following steps:

1. In the Object Tree, select the station to be engineered.
2. Select **Tools > Signal Engineering** from the menu bar, as shown in Fig. 4.1.15.1.-2.

The station configuration page opens for editing.

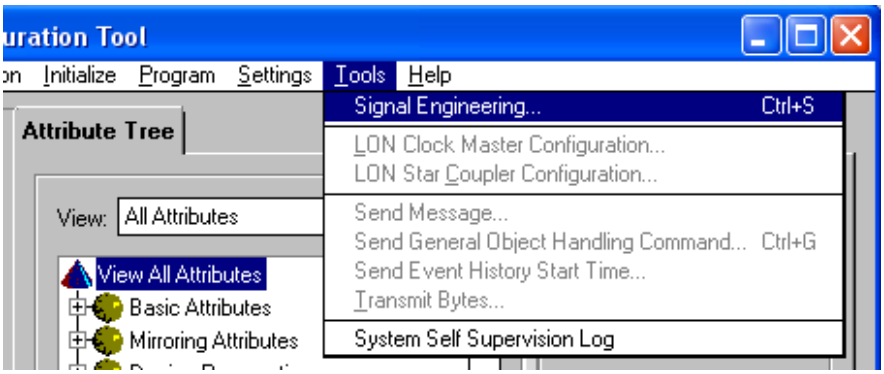


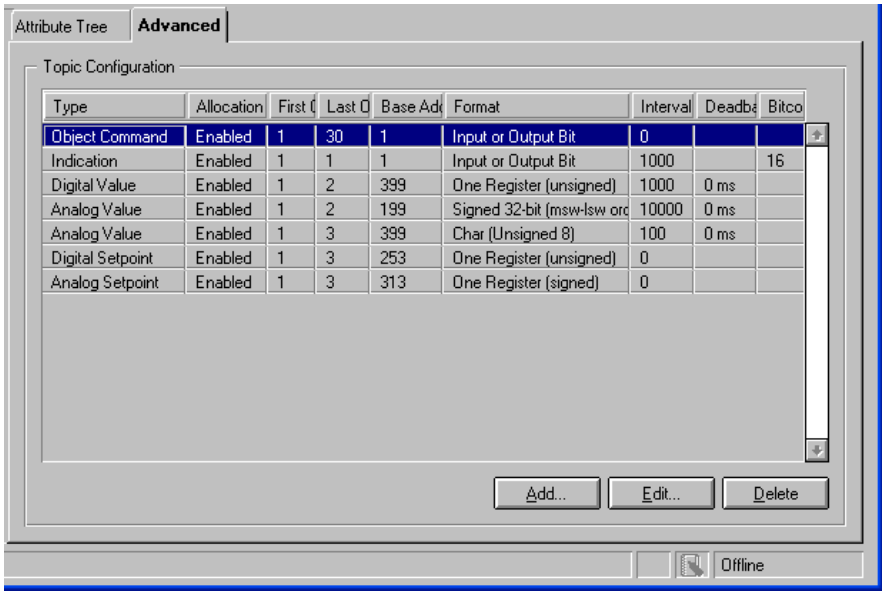
Fig. 4.1.15.1.-2 The station configuration page is opened

4.1.15.2. REX, LMK and SPA stations

For more information about the signal engineering for the REX, LMK and SPA stations, refer to ***Connecting LONWORKS Devices*** manual.

4.1.15.3. Topic configuration for PLC stations

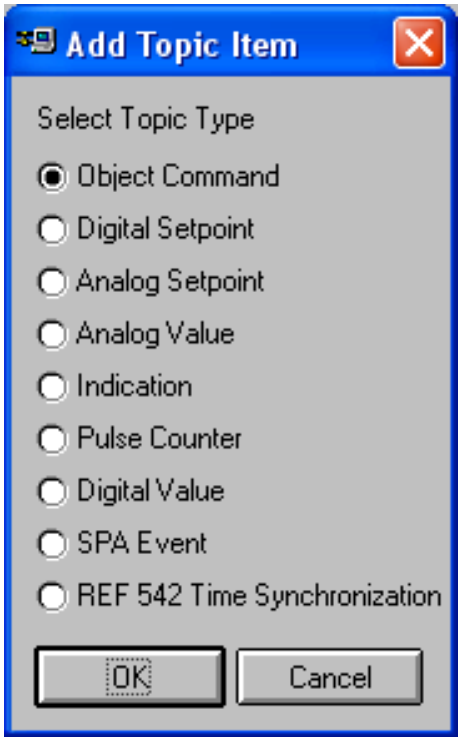
Topic configuration is done in the Advanced page for the PLC stations.



A060292

Fig. 4.1.15.3.-1 The topic information of a PLC station in the Advanced page of the System Configuration tool

To add a new topic item, click the **Add** button, which opens the **Add Topic Item** dialog, as shown in Fig 4.1.15.3.-2. In this dialog, the default topic type is object command or the type of the last added topic item. The maximum number of topic items for each device is 100. If the station already includes 100 topic items, the **Add** button is disabled.



A060299

Fig. 4.1.15.3.-2 New topic item Object Command is added to a PLC station

To delete existing topic items, select the appropriate item in the list and click the **Delete** button. Before the deletion is done, a notification dialog is displayed to the user. Clicking **Yes** deletes the selected topic item and refreshes the list. Clicking **No** cancels the delete operation.

To edit an existing topic item, select the appropriate topic item in the list and click the **Edit** button. Editing can also be done by double-clicking the topic item. The selected topic items are displayed in the **Topic Configuration Editor** with the existing definitions, as shown in Fig 4.1.15.3.-3. In this dialog, the topic type, allocation, first object address, last object address, base address, format, interval and deadband are defined.

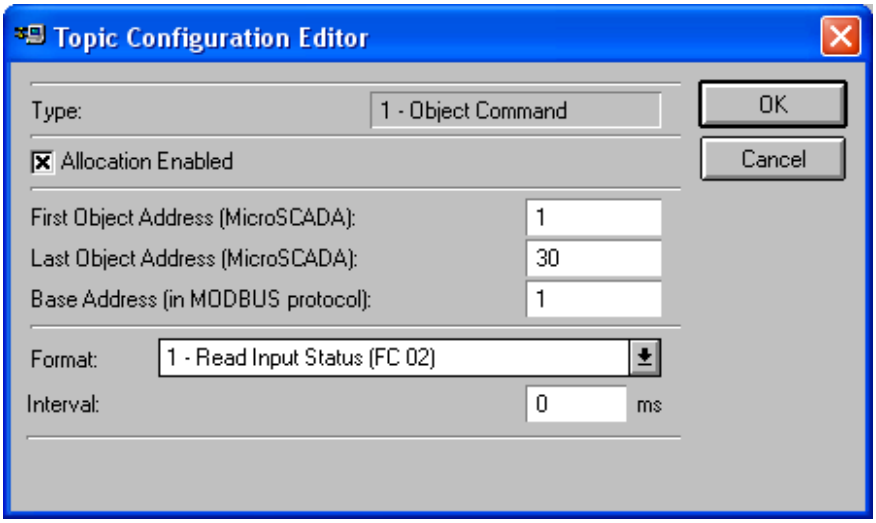


Fig. 4.1.15.3.-3 In this dialog an existing topic item can be edited

Note that with indication type one object address (OA) contains 16 bits and it includes both single and double indications.

Allocation

This item specifies whether the topic is in use or not. The memory needed for the topic is reserved, when the topic is taken into use. Values: Enabled or disabled.

First Object Address

This parameter specifies the first object address used with this topic. Object address and object type parameters specify together the actual process object address (OA), where the first item in the topic is stored. Values: 1 … 4096.

Last Object Address

The object address of the last item of topic. Values: 1 … 4096. The number of items reserved by the topic is calculated in the following way:

- Number of items = Last object address - First object address

Base Address

The address of first item of topic in the device's memory. Values: 0 … 65535.

Format

Specifies how the data is stored in an external device.

Interval

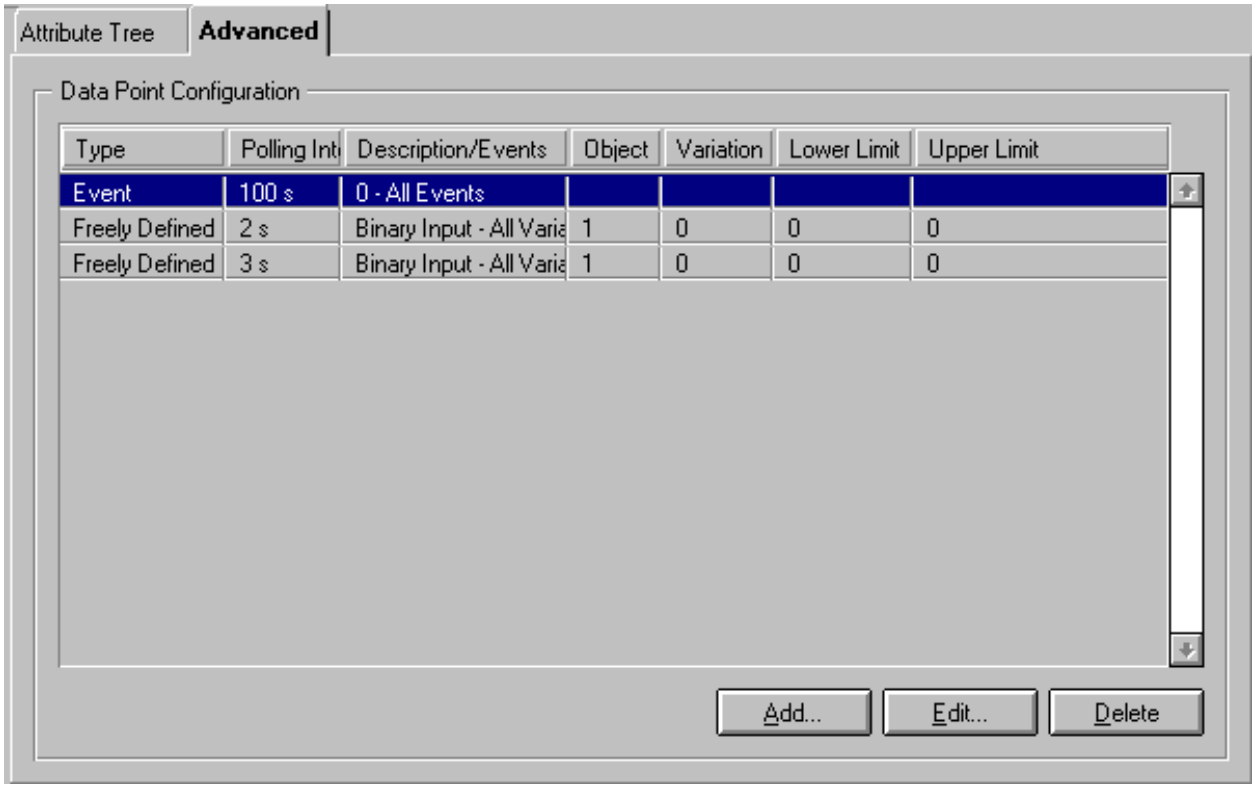
Specifies the frequency that the data of topic is read from an external device. The interval units are milliseconds. If the interval is 0, the topic is not polled. Values: 0 … 65535.

Deadband

If the type of topic is an analog value, then the deadband value is used to minimize the amount of updating messages from the PC-NET to the base system. The new analog value is sent to the base system, when the change or sum (integral) of changes is bigger than the deadband. Values: 0 … 65535.

4.1.15.4. Configuring data points for DNP stations

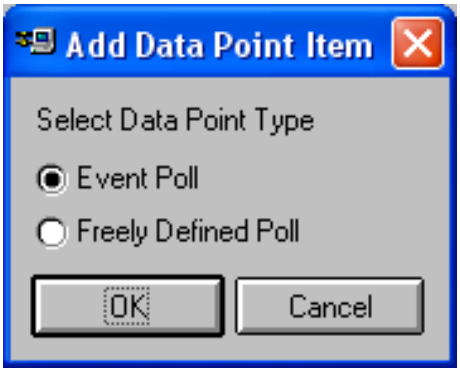
DNP V3.00 protocol provides versatile possibilities for data polling. In DNP V3.00, the data polling can be configured in a different way in each DNP V3.00 master device. The data polling for DNP master station is defined in the Advanced page of the System Configuration tool, as shown in Fig 4.1.15.4.-1.



A060304

Fig. 4.1.15.4.-1 The data point configuration of DNP station in the Advanced page of the System Configuration tool

To add a new item, click the **Add** button. This action opens the **Add Data Point Item** dialog, as shown in Fig 4.1.15.4.-2. In this dialog, the default type is event poll. If the DNP station already contains the defined event poll item, the default type is always freely defined poll. If DNP station already includes the maximum number of data point items, the **Add** button is disabled, because there may be maximum fifty freely defined data point items for one DNP device.

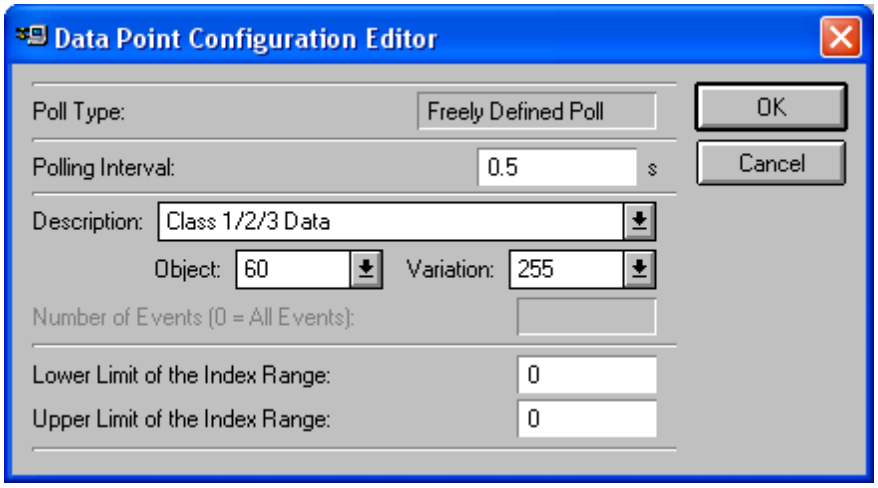


A060305

Fig. 4.1.15.4.-2 New data point item type for DNP station

To delete the existing data point items, select the appropriate item in the list and click **Delete**. Before the delete operation is done, a notification dialog is displayed to the user. Click **Yes** to delete the selected data point item and refreshes the list. Click **No** to cancel the deletion.

To edit the existing data point item, select the appropriate item in the list and click **Edit** or double-click the data point item. The selected items are displayed in the Data Point Configuration Editor with the existing definitions, as shown in Fig 4.1.15.4.-3. In this dialog, the poll type, polling interval, object, variation, description, number of events and lower/upper limit of index range are defined.



A060306

Fig. 4.1.15.4.-3 Editing the existing data point item

Poll Type

Specifies the poll type of a data point item. There may be one event poll and maximum 50 freely defined polls for a DNP station.

Polling Interval

Specifies the polling interval as seconds. Setting this parameter to zero stops the poll, which is the default for freely defined poll. For event poll, the default is 100.

Description, Object and Variation

A combination of Object and Variation specifies the information element structure for a data point item. It is also possible to select the information element structure directly from the Description list. In both cases, only the relevant Object and Variations appear in the lists.

Number of Events

Specifies the number of events to be polled. Value 0 indicates that all events are to be polled. Default value is 0.

Lower Limit of Index Range

Specifies the lower limit of the index range. If 0, all data points with the given data object type and variation are polled. Default value 0.

Upper Limit of Index Range

Specifies the upper limit of the index range. If 0, all data points with the given data object type and variation are polled. Default value 0.

All the above definitions are applicable to the freely defined poll. For an event poll, only the Polling Interval and Number of Events are applicable.

4.1.15.5. Configuring memory areas for STA stations

For STA stations the memory area configuration for data items is defined in the Advanced page, as shown in Fig 4.1.15.5.-1.

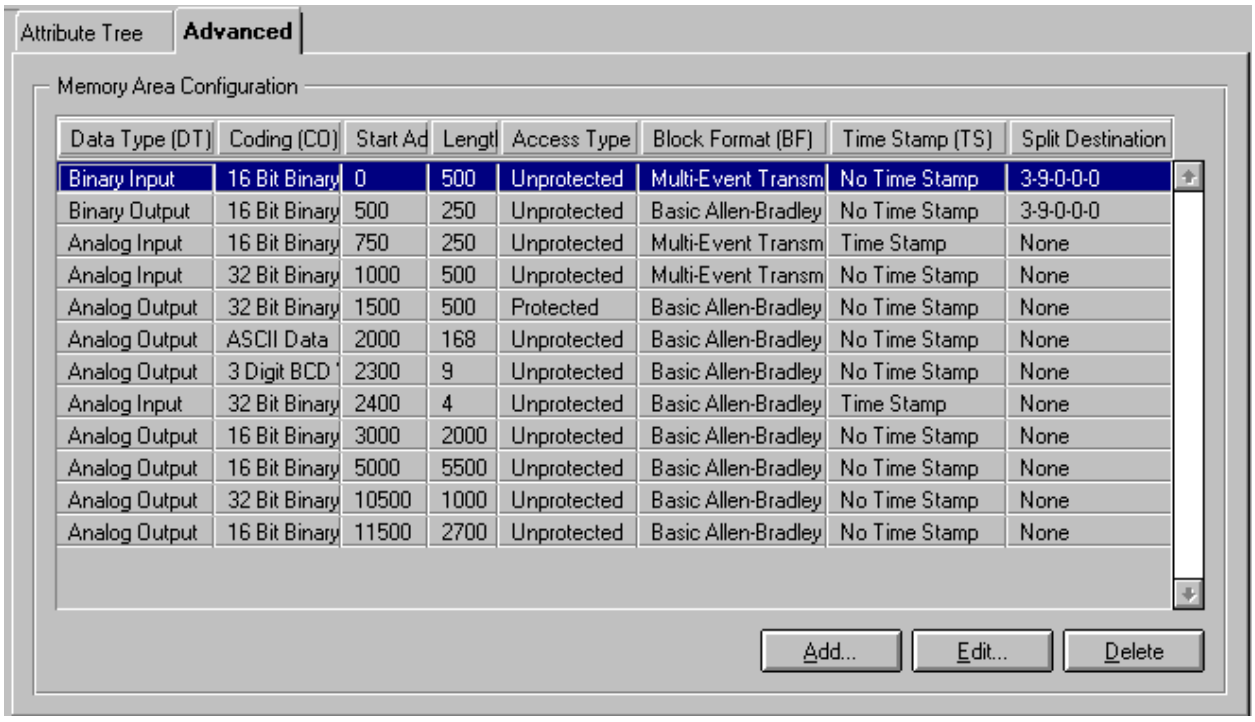

Attribute Tree
Advanced
Memory Area Configuration
Data Type (DT)
Coding (CO)
Start Ad
Lengt
Access Type
Block Format (BF)
Time Stamp (TS)
Split Destination
Binary Input 16 Bit Binary 0 500 Unprotected Multi-Event Transm No Time Stamp 3-9-0-0-0
Binary Output 16 Bit Binary 500 250 Unprotected Basic Allen-Bradley No Time Stamp 3-9-0-0-0
Analog Input 16 Bit Binary 750 250 Unprotected Multi-Event Transm Time Stamp None
Analog Input 32 Bit Binary 1000 500 Unprotected Multi-Event Transm No Time Stamp None
Analog Output 32 Bit Binary 1500 500 Protected Basic Allen-Bradley No Time Stamp None
Analog Output ASCII Data 2000 168 Unprotected Basic Allen-Bradley No Time Stamp None
Analog Output 3 Digit BCD 2300 9 Unprotected Basic Allen-Bradley No Time Stamp None
Analog Input 32 Bit Binary 2400 4 Unprotected Basic Allen-Bradley Time Stamp None
Analog Output 16 Bit Binary 3000 2000 Unprotected Basic Allen-Bradley No Time Stamp None
Analog Output 16 Bit Binary 5000 5500 Unprotected Basic Allen-Bradley No Time Stamp None
Analog Output 32 Bit Binary 10500 1000 Unprotected Basic Allen-Bradley No Time Stamp None
Analog Output 16 Bit Binary 11500 2700 Unprotected Basic Allen-Bradley No Time Stamp None
Add...
Edit...
Delete
A060301

Fig. 4.1.15.5.-1 The memory area configuration of STA station in the Advanced page of the System Configuration tool

To add a new item, click the **Add** button, which opens the Add Memory Area Item dialog as shown in Fig 4.1.15.5.-2. In this dialog, the default type is binary input or the type of the last added item. If STA station already includes 30 items, the **Add** button is disabled, as the maximum number of the memory area items for each STA device is 30.

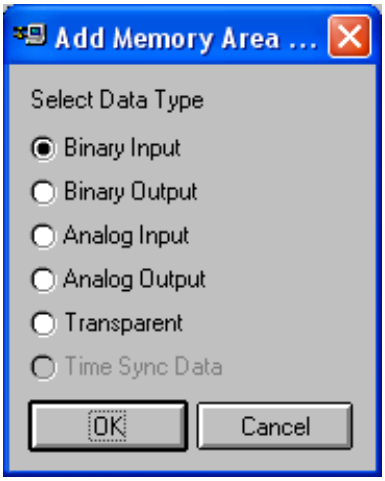


Fig. 4.1.15.5.-2 New memory area item, Binary Input, is added to the STA station

To delete the existing memory area items, select the appropriate item in the list and click **Delete**. Before the deletion is done, a notification dialog is displayed to the user. Click **Yes** to delete the selected memory area item and refreshes the list. Click **No** cancel the delete operation.

To edit the existing memory area item select the appropriate item in the list and click **Edit** or double-click the memory area item. The selected items are displayed in the Memory Area Configuration Editor with the existing definitions, as shown in Fig 4.1.15.5.-3. In this dialog, the data type, coding, start address, length, access type, block format, time stamp and split destination are defined.

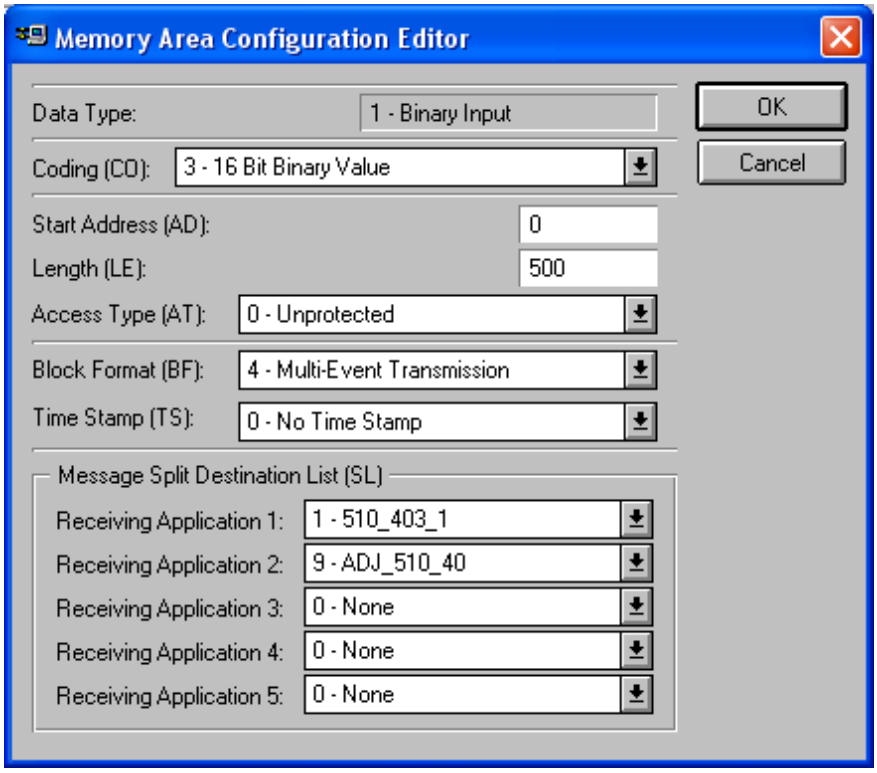


Fig. 4.1.15.5.-3 Editing the existing memory area item

Data Type

Specifies the data type of process objects. The following data types of STA device are available: Binary Input, Binary Output, Analog Input, Analog Output, Transparent and Time Sync Data.

Coding

Coding of the data elements in the address interval defined by the memory area. The value of CO attribute tells the communication program how to interpret the data of the memory area.

Values:

1 - 8 Bit Binary Value

2 - 12 Bit Binary Value

3 - 16 Bit Binary Value

4 - 32 Bit Binary Value

5 - 3 Digit BCD Value

6 - 4 Digit BCD Value

7 - Not in Use

8 - Not in Use

9 - 32 Bit Floating Point Value

10 - ASCII Data

11 - 16 Bit Integer Value

12 - 32 Bit Integer Value

Start Address

The word address of the first word's memory area. Value range: 0 - 32767.

Length

Number of words in the memory area. Value range: 0 - 32767.

Access Type

Defines whether the write commands directed to this memory area are protected or unprotected. The attribute is relevant only to Allen Bradley stations. Values:

0 = Unprotected

1 = Protected

Block Format

States if the spontaneous command messages from the station use the basic format of the protocol, or if an additional address field is used. Values:

1 = Basic Allen-Bradley

2 = Special 1 (the message contains a second word address, which is a BCD coded octal number)

3 = Special 2 (the message contains a second, binary word address)

4 = Multi-Event Transmission (allows transmission of many events with non-continuous addresses in the same telegram)

Time Stamp

States whether the time tagged information is included in spontaneous commands from the station. Values:

0 = No Time Stamp

1 = Time Stamp

Message Split Destination List

Defines the applications that will receive the message. Receiving applications can only be defined if Message Split attribute of station is defined (SP > 0).

4.2. Base System Tool

This section describes the general features of Base System tool:

The Base System Object Navigator tool is an on-line tool that provides the following common functionality:

- Recognizing of the base system objects in SYS 600 system.
- Viewing of the base system related attributes and their values
- Editing of the base system object related attribute values.
- Adding of base system objects.

Because the tool is an on-line tool, the modified attribute values or added base system objects affect only the running system. If there is need to configure the system permanently, the changes should be made to base system configuration files (e.g. sys_bascon.com or sys_bascon.hsb).

5. Abbreviations

Abbreviation	Description
IP	Internet protocol
LAN	Local area network
RAS	Remote Access Service
SCIL	Supervisory Control Implementation Language
WAN	Wireless network

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ABB Oy
Substation Automation Products
P.O. Box 699
FI-65101 Vaasa
FINLAND
+358 10 2211
+358 10 224 1094
www.abb.com/substationautomation